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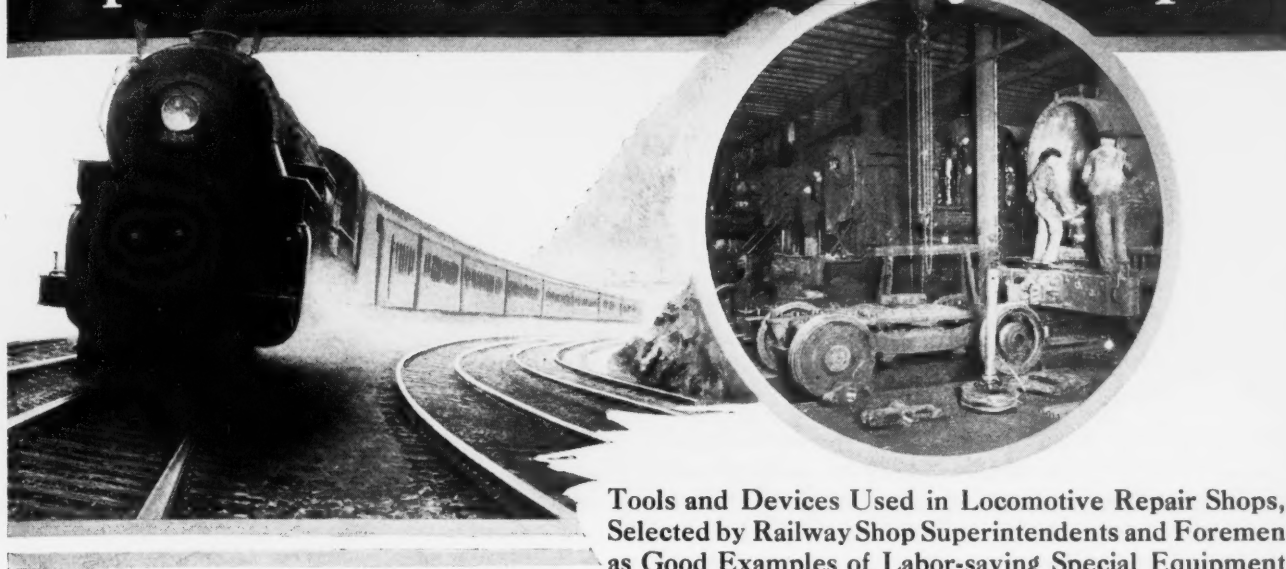
MACHINERY

Volume 34

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Number 10

Special Tools for Railway Shops



Tools and Devices Used in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-saving Special Equipment

THERE are many operations in locomotive repair shops for which standard equipment is not available on the market, and special tools have, therefore, been developed by the men in charge of these shops. In almost every locomotive repair shop, there are some special tools, gages, and other devices that have proved exceptionally useful, and in many shops a machine tool or some shop equipment is employed in an unusual way either to save time and labor or to improve the quality of the work.

MACHINERY has secured directly from railway shop superintendents and foremen throughout the country, descriptions of as many of these special tools as possible, and will publish this information for the benefit of the men responsible for results in railroad repair shops in a number of articles, of which this one is the first. Such an exchange of ideas has proved of great practical value in the past, because the man that contributes an idea receives through these pages equally valuable ideas in return. The devices that are described in these articles have been selected by experienced railway shop superintendents and foremen because of the savings and advantages that have resulted from the use of these particular tools in their own shops.

PLANING FIXTURES FOR LOCOMOTIVE DRIVING-BOX SHOES AND WEDGES

By HENRY H. HENSON, Foreman Machine and Erecting Shop, Southern Railway Co.

Various methods are used in planing and milling locomotive driving-box wedges and shoes. In Fig. 1 is shown a planer equipped with tools and fixtures for machining a row of shoes *A* and a row of wedges *B* simultaneously. The details of one of the work-holding fixtures are shown in Fig. 2. The design of the holder for the planing tools is shown in Fig. 4. With this fixture and tool equipment arranged as shown in Fig. 1, it is possible to plane all the surfaces on the shoes and wedges in one set-up, with the exception of the box face. This surface remains unfinished until the part is required for construction or repair work in the erecting shop or engine house.

As will be noted from Fig. 4, provision is made for holding four tools in the tool-head. There are two of these heads, as shown in Fig. 1, holding, in all, eight tools or cutters, which take four cuts on each row of shoes simultaneously. Thus both the outside and inside surfaces are planed at one time. The writer believes this to be the most prac-

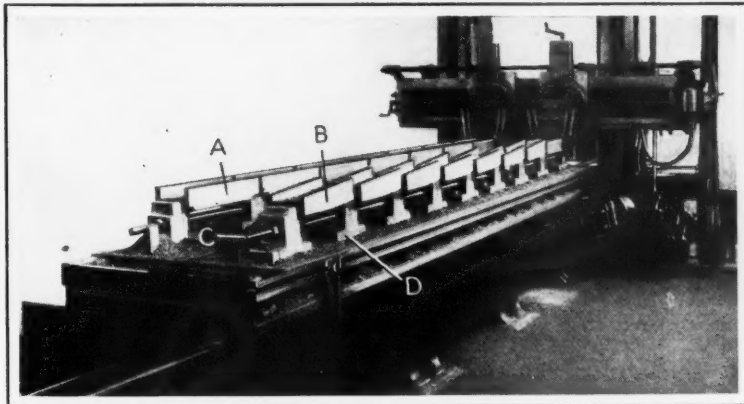


Fig. 1. Gang-planing Locomotive Driving-box Shoes and Wedges

tical method of handling such work. The shoes and wedges seen in Fig. 1 are of the large size type, having a "frame fit" width of 6 inches. The driving-box fit dimensions are given as 8 inches wide by 23 inches long. The wedges have the same dimensions except that they are 19 inches long.

Chucks or clamps like the one shown in Fig. 2, which are bolted to the planer table, hold the shoes and wedges securely in place. The number of chucks used depends upon the length of the planer table or the number of shoes and wedges to be planed in one set-up. The chucks are first put on the planer

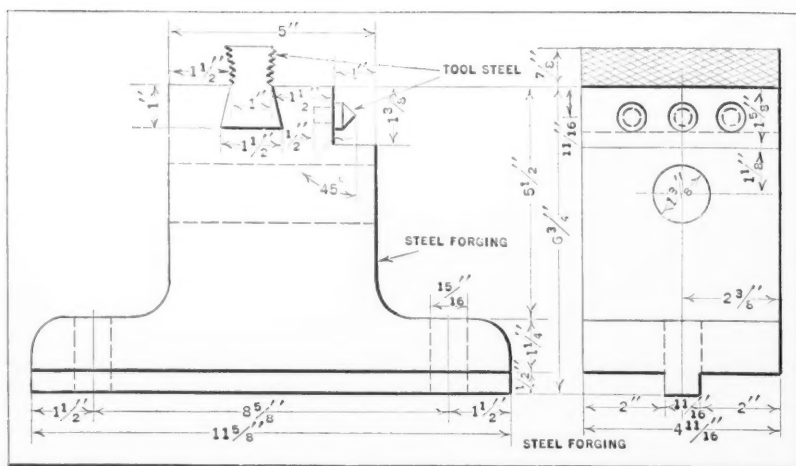


Fig. 2. Details of One of the Work-holding Fixtures D, Fig. 1

and a 3/4- by 1 1/2- by 14-inch tool is placed in the center holder D, Fig. 4. This tool is used to plane the bottom surface E.

The tool-holder body is made in two different sizes, the dimensions shown being those of the small size holder. The central tool bit holder D can be

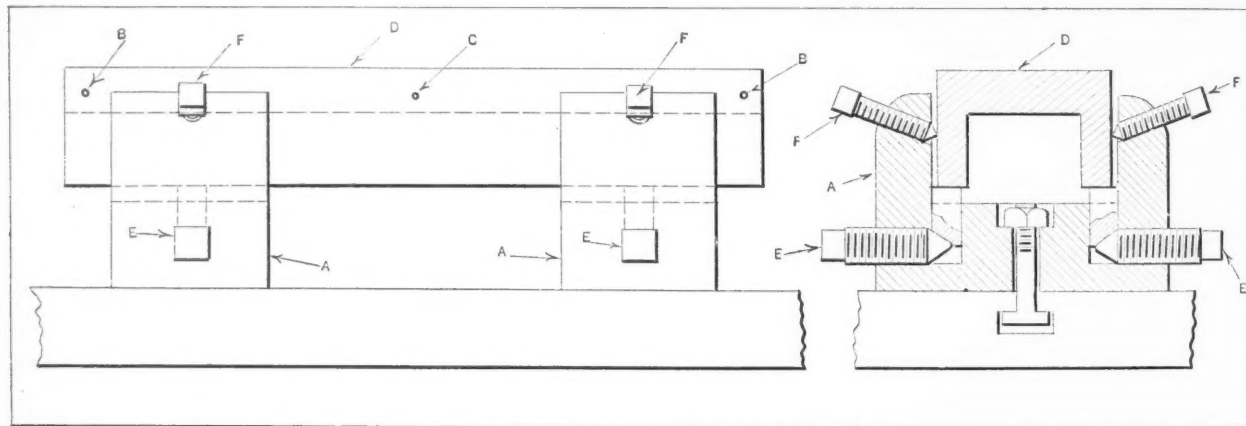


Fig. 3. Fixtures Used in Planing Faces of Driving-box Shoes and Wedges

table, the two at the front end being bolted securely against two stop-pins, as shown in Fig. 1. The other chucks are left loose on the table until after they are clamped together with a 1 1/4-inch tie-rod C. The nuts on all the T-head bolts which clamp the chucks to the planer table are then tightened.

The tool-holder shown in Fig. 4 is placed in position, as shown in Fig. 1, being held in place by four studs C, Fig. 4, on the clapper-box head of the planer cross-rail. The tool bits or cutters are next placed in their respective holders and adjusted to plane the work to the required dimensions. Tools G and H plane the outer surfaces,

made to suit the different sizes of shoes and wedges to be machined.

The tool-holder shown in Fig. 4 and the chuck or clamp shown in Fig. 2 are steel forgings. The tool bit holders or clappers L, M, and N, Fig. 4, fitted in slots in the cast-steel body O are forged steel.

The holders are pivoted at their upper ends on steel taper pins. These pins and all set-screws are hardened tool steel. Tools and work-holding chucks or fixtures like the ones described can be used to advantage on other planer production work, of the same general class, as, for example, cross-head shoes, and engine and trailer truck brasses.

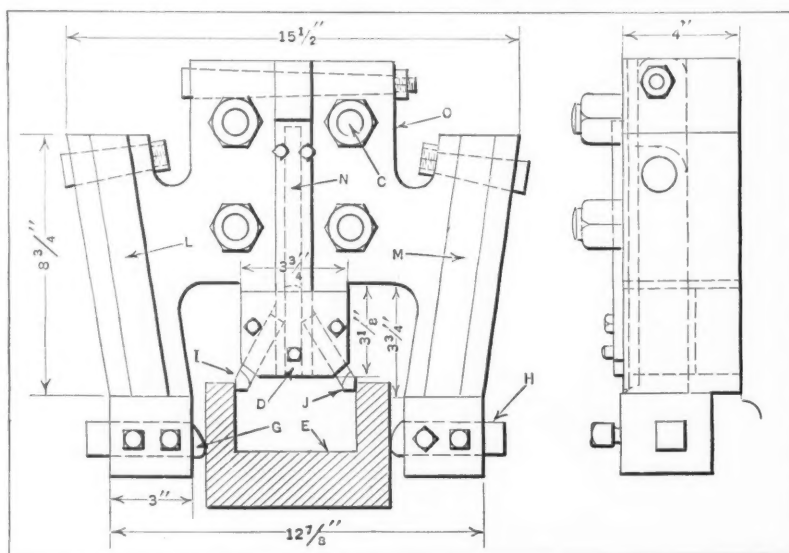


Fig. 4. One of the Tool-heads Used in Set-up Shown in Fig. 1

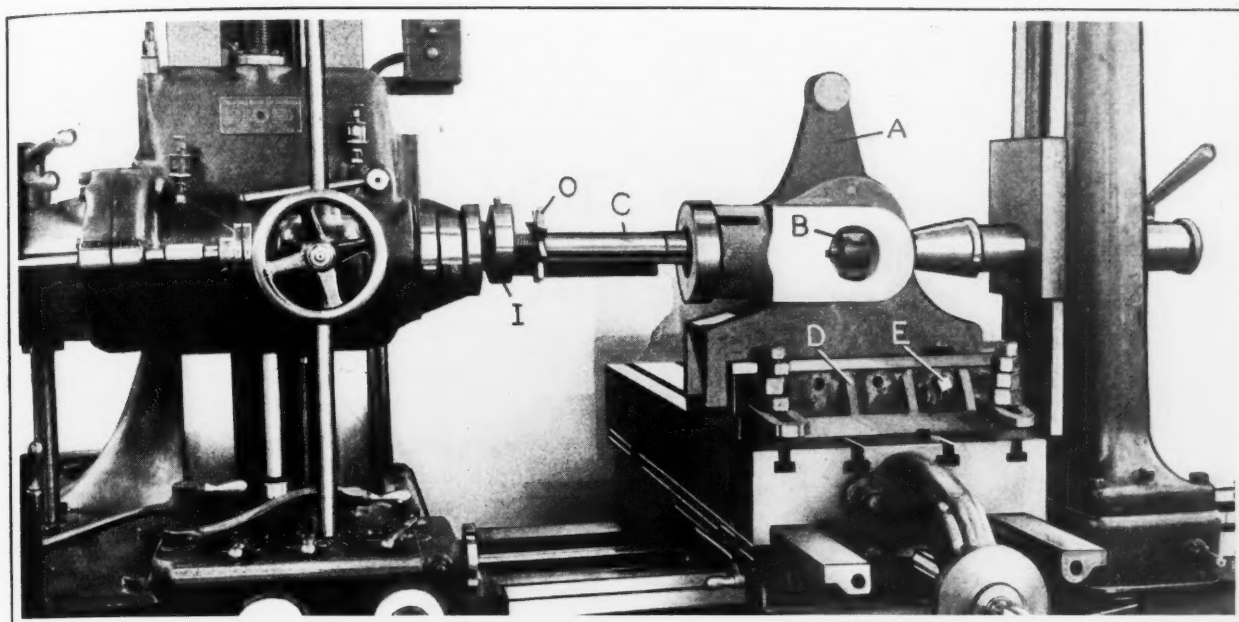


Fig. 1. Taper-boring Locomotive Cross-head for Piston-rod Fit

The planing of the face surfaces of the shoes and wedges, after these parts have been "laid off" in the erecting shop, is done with the work held in fixtures like the ones shown at A, Fig. 3. Two prick-punch marks, as shown at B, on one side of the shoe or wedge, and one mark at C, on the other side, serve as a means for locating the work for finishing the top surface D. The work is raised or lowered to bring the prick-punch marks into alignment with the three gaging points of a surface gage, by adjusting the set-screws E.

After the work has been properly lined up, it is clamped in position by tightening the set-screws F. Ordinarily, the work is so "laid off" that the upper surface is planed to within 1 inch of the prick-punch marks. Two chucks like the one shown at A are required for each piece, and as many pieces as

the length of the planer bed will accommodate can be set up for planing at one time.

ATTACHMENT FOR BORING TAPER HOLES IN LOCOMOTIVE CROSS-HEADS

By J. B. IRWIN, Shop Superintendent, Chicago, Burlington and Quincy Railroad Co.

One of the important operations on locomotive cross-heads is that of boring the taper holes for the piston-rod and the cross-head pin. A horizontal boring machine equipped with a taper boring-bar and a work-holding fixture for work of this kind is shown in Figs. 1 and 3.

The cross-head A, Fig. 1, is shown in position for boring the tapered hole for the piston-rod. One of the advantages gained by using a machine equipped

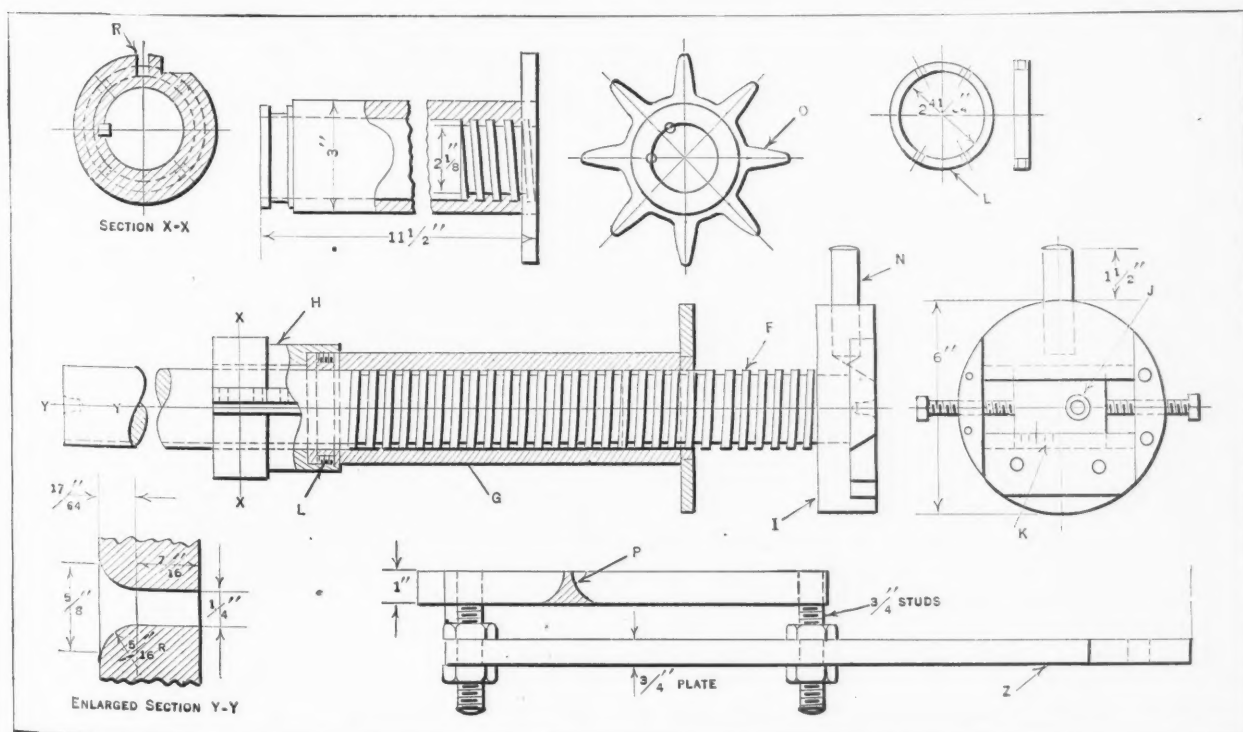


Fig. 2. Details of Important Parts of Taper-boring Bar Shown in Fig. 1

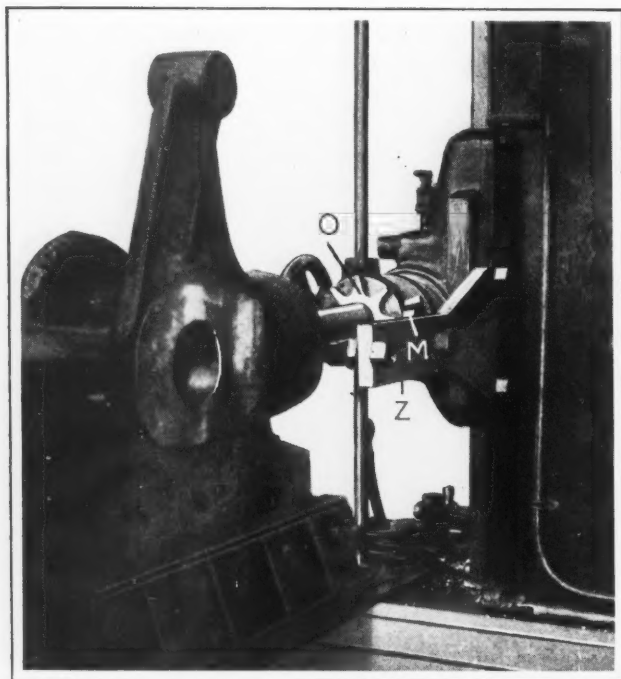


Fig. 3. Rear View of Set-up Shown in Fig. 1

as illustrated is that both tapered holes can be bored without unclamping the work in the fixture. After finishing one bore, it is a simple matter to turn or index the work-holding fixture through an angle of 90 degrees in order to bring it into position for boring the second hole at right angles with the first.

The work-holding fixture has a rib through its center which is parallel with the sides *D*. The central rib is drilled and tapped to receive conical head studs which can be adjusted to support the sides of the cross-head when it is clamped in position by the set-screws *E*. Where much of this work is done, two fixtures are provided, so that one can be loaded by a bench man while the other is in use. The machine is thus kept in continuous operation.

Some of the more important details of the taper boring-bar are shown in Fig. 2. At *F* is shown the main spindle which is held between the boring mill centers. This spindle is 2 3/4 inches in diameter and 27 inches long. The end nearest the machine headstock is threaded for a distance of 14 inches with a left-hand, 1/4-inch pitch, square thread, which serves to impart the required feeding movement to the sleeve *G* on which the boring tool-head *H* is mounted. Head *H*, which holds the boring tool in slot *R*, is a close sliding fit on the unthreaded portion of spindle *F* and is provided with a key which slides in a keyway cut in the spindle.

The live center of the machine spindle enters the center *J* of the dovetail slide in the head *I* secured to the end of spindle *F*. By throwing the supporting center *J* off center with respect to the center of the spindle *F*, the path of the boring tool, as it travels along the revolving spindle, is such that a tapered hole is produced. Graduations at *K* show when the dovetail slide is properly adjusted for boring the tapers most commonly required. The enlarged section *Y-Y* shows the form or shape of the center *J* as well as that at the opposite end of the spindle.

A split ring *L*, which is a running fit in a groove at the end of sleeve *G*, serves to keep these members properly assembled. The half-sections of the

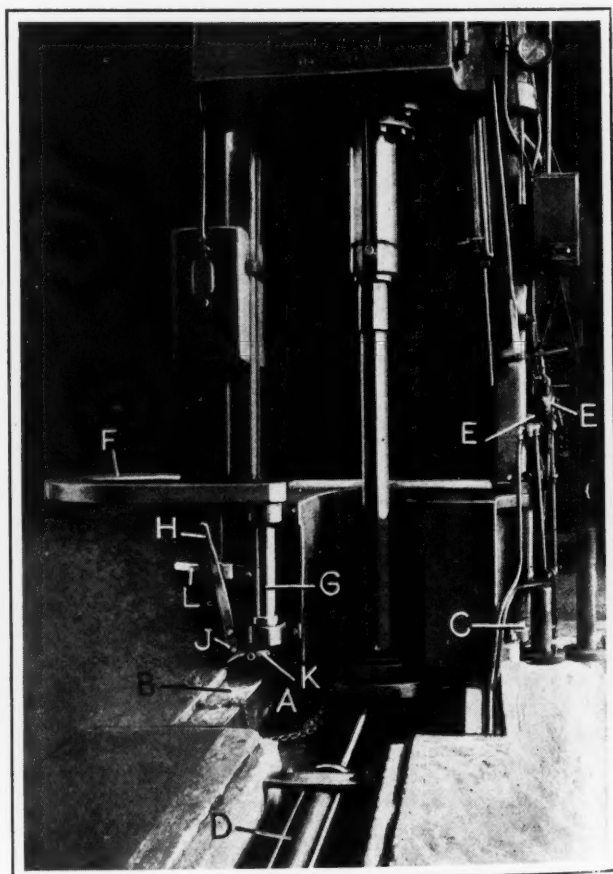
ring *L* are secured to head *H* with machine screws. A stud *M*, Fig. 3, which makes contact with the pin *N*, Fig. 2, transmits the drive from the machine spindle. The cross-section of the bar which actuates the star-wheel *O* of the feed-screw is shown at *P*. The threaded studs which support this bar can be adjusted to make proper contact with the teeth of the star-wheel. The supporting strap *Z* is secured to the boring machine as shown in Fig. 3.

HYDRAULIC PRESS EQUIPPED FOR PRESSING-IN PISTON-RODS AND CROWN BRASSES

By SAM B. HARLAN, Machine Shop Foreman, New York Central Railroad Co.

A Chambersburg 100-ton hydraulic bushing press equipped for pressing locomotive piston-rods into their heads, removing the rods, and applying or removing crown brasses from driving-boxes is shown in the accompanying illustration. The first step in equipping the press for this work was to provide and apply an auxiliary base *A*, 4 inches thick, and two parallels *B* having a depth of 8 inches. The two nuts on the column bolts were removed and nuts having shanks *C*, which served as spacers, placed between the press and the auxiliary base. The nuts removed from the column bolts were then replaced and tightened against the bottom plate. The bottom plate has a slot which provides clearance for the piston-rod nut when pressing a rod into the piston-head.

The head in which a piston-rod is to be pressed is placed on the auxiliary base and pushed under the base of the machine by the small air hoist *D* located in a horizontal position below the floor



Press Equipped with Air-operated Work Table and Swinging Work Support

level. A chain attached to the piston-rod of the air hoist and placed around the piston-head in the ring groove serves to pull the work from under the machine base. The work can be either pushed under the press ram or withdrawn by operating the control valves *E* which permit air to be admitted to either end of the cylinder as required. The auxiliary base *A* is placed below the floor level. The illustration shows the machine with the floor boards removed.

When removing piston-rods from their heads, the head is placed on the base of the machine and the piston-rod pressed out into a pit 40 inches deep which extends below the auxiliary base. The rod is removed from the pit by an overhead air hoist. The pit is so constructed that the piston-rod will tilt or fall toward the front of the slot in the machine base, thus facilitating its removal.

The difficulty experienced in getting a driving-box into the proper position for pressing out or pressing in the crown brass was overcome as follows: The horseshoe-shaped base *F* for supporting the driving-box was attached to the front side of the machine base as shown in the illustration. The shaft *G*, on which the base *F* is mounted, is supported by two boxes equipped with roller bearings. The lower end of the shaft is equipped with a thrust bearing. The hand-lever *H* has a roller *J* mounted on the short arm at its lower end, which acts on a taper surface on the fulcrum lever *K*.

When the lever *H* is pulled to the left the horseshoe-shaped base is raised so that it clears the machine base by about $\frac{3}{8}$ inch. When pulled way back, lever *H* is caught by the spring latch *L*. The

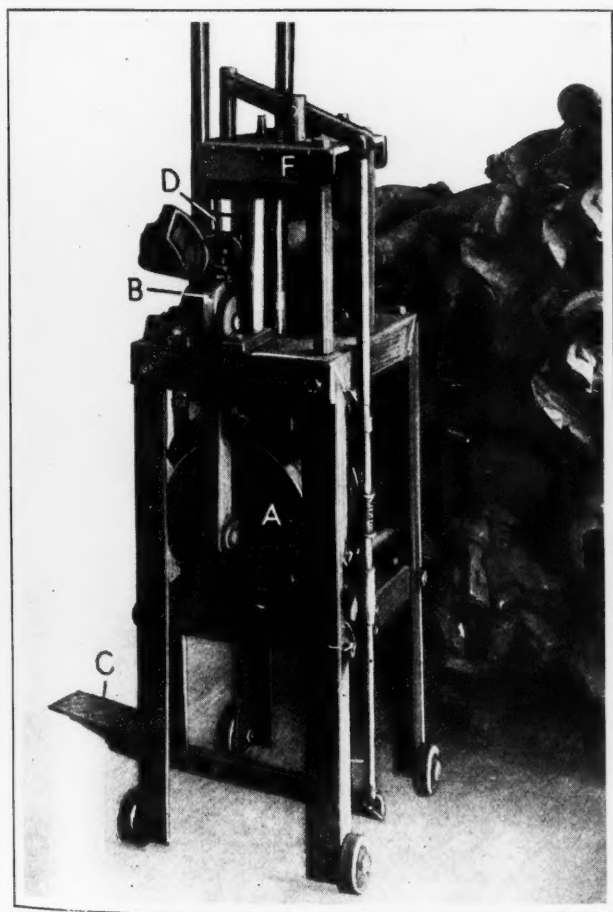


Fig. 1. Nut-removing and Nut-tightening Machine for Steam-hose Fittings

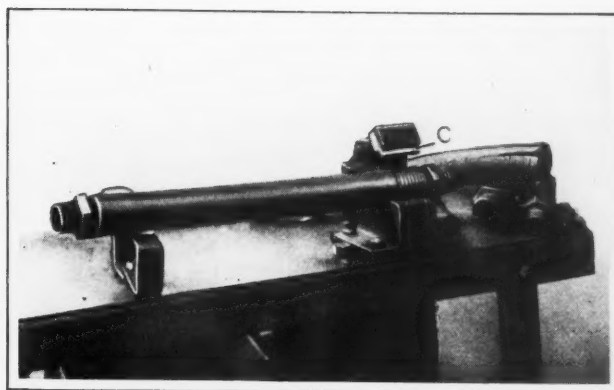


Fig. 2. Hose-splitting Device Used in Removing Fittings

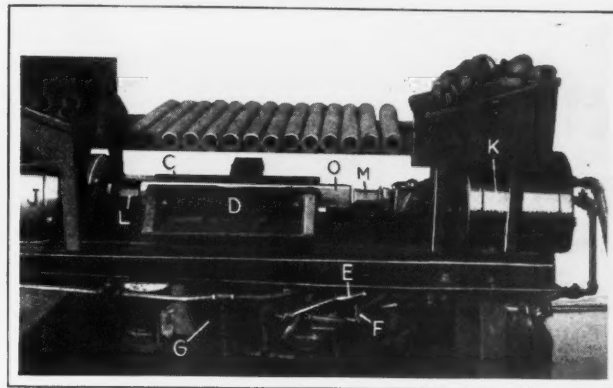


Fig. 3. Machine for Assembling Fittings in Steam Hose

base *F* can then be easily swung under the press ram or swung outward into the work-loading position. The work is placed on base *F* by means of an overhead air hoist. After swinging the base which carries the work into position under the press ram, where it is located by a stop, the operator kicks the spring latch out of engagement with lever *H*. This allows the base *F* and the work to drop down on the machine base. The crown brass can then be removed or pressed into place as required. After the press operation is completed, the table is again raised and swung outward so that the work can be easily picked up by an overhead air-operated hoist. When the press is used for piston assembly work, the base *F* is swung around out of the way as shown in the illustration.

REMOVING AND APPLYING STEAM-HOSE FITTINGS

By OBSERVER

The equipment described and illustrated in this article is employed for removing couplings or fittings from worn out steam hose of railway heating systems and applying them to new hose. The machine shown in Figs. 1 and 4 is used for removing the nuts from the bolts that secure the hose clamps and also for tightening the nuts when applying the clamps to new hose. The machine illustrated in Fig. 2 splits the old hose at the ends so that the fittings can be removed. In Fig. 7 is shown the machine used to press the fittings into the ends of a new hose.

The machine shown in Fig. 1, which may be termed a power wrench, not only provides the quickest means yet found for removing the bolts from the hose couplings, but accomplishes its work

without damage to the bolts or nuts. Referring to Figs. 1 and 4, the piston of the air cylinder *A* is connected to the outer end of the movable jaw *B* of the clamp which grips the head of the bolt to be removed.

After locating the bolt head between the clamping jaws, as shown in Fig. 1, the operator depresses the foot-pedal *C*. This opens the air valve leading to cylinder *A* and causes the jaw *B* to grip the bolt head securely, while a further downward movement of the foot-pedal brings the chuck *D* down over the nut to be removed. Chuck *D*, which is driven by the air motor *E* through a gear train located in the head *F*, quickly removes the nut.

After all the nuts are removed, the bolts and the clamps are dropped into a pail containing a mixture of kerosene and graphite. About 98 per cent of these parts are suitable for use, whereas with the old method of cutting off the bolts with a power nipper or an acetylene torch, all the bolts were destroyed. As these bolts cost about two cents each, a saving of eight cents is made on each hose repaired. The spindle of the machine can be run in either direction, as required, for removing or tightening the nuts.

After the clamps have been removed, the ends of the hose are split by the machine shown in Fig. 2, so that the couplings or fittings can be removed. Details of the splitting cutter and its holder are shown in Fig. 5. The lever *A*, which carries the splitting cutter *C*, is operated by the piston *B* of an 8- by 7-inch air-brake cylinder *D* secured to the under side of the table. The piston *B* is controlled by a foot-operated air valve. The removable blade *C* is notched to match the beads on the stems of the

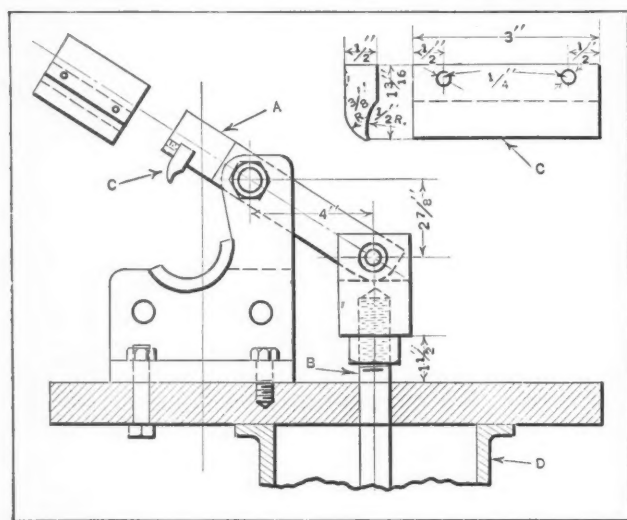


Fig. 5. End View of Hose-splitting Device Shown in Fig. 2

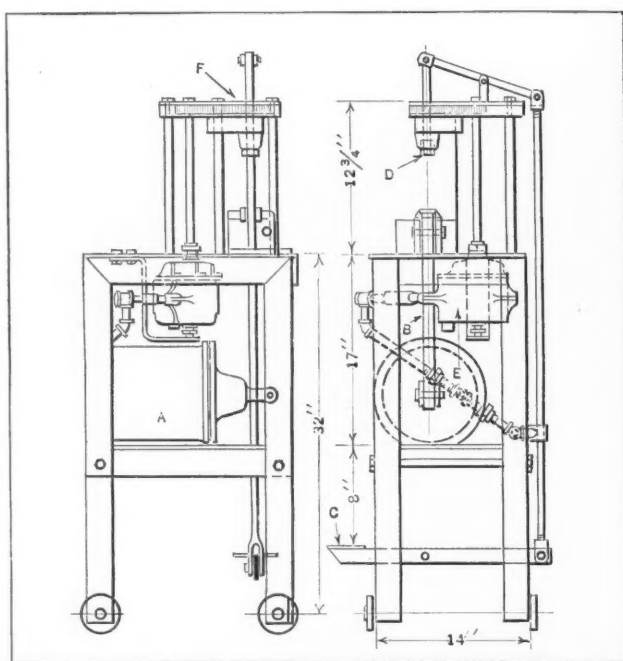


Fig. 4. Front and Side Views of Machine Shown in Fig. 1

An end view of the jaws *C* and *D*, which grip the hose while forcing in the fittings, is shown in Fig. 6. The pieces of hose on which fittings are to be assembled are placed on a shelf above the clamping jaws, as shown in Fig. 3, and the fittings are conveniently located in sheet-metal containers at each end of the machine.

When the assembling machine is in operation, the workman places a fitting on each of the holders *A* and *B*, Fig. 7, as shown in Fig. 3. A length of hose *O* is then placed between the clamping jaws *C* and *D* and the valve handle *F* raised. Next the operating lever *E* is turned to a vertical position. This causes the jaw *C*, actuated by the piston of cylinder *G*, to advance and clamp the hose securely in position, while the pistons of cylinders *J* and *K* advance and force the fittings *L* and *M* into the ends of the hose.

Lever *E* and handle *F* are then returned to their original positions. This permits the air to escape from cylinders *J* and *K*, so that the springs *Q* and *R*, Fig. 7, withdraw the holders *A* and *B*, leaving the fittings pressed into the hose. The air valve

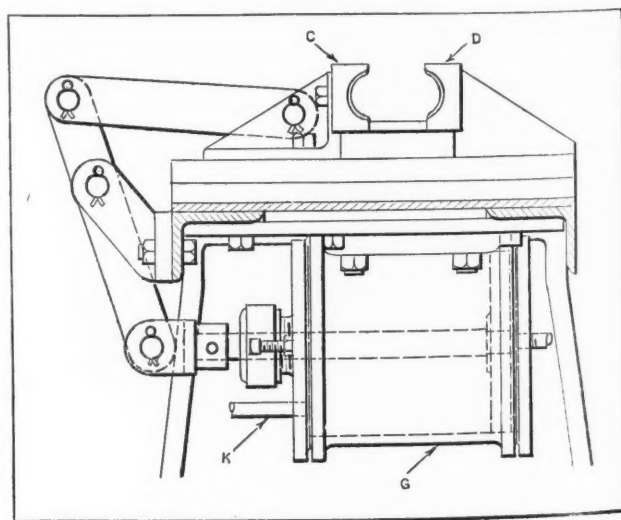


Fig. 6. Work-clamping Mechanism of Machine Shown in Figs. 3 and 7

controlled by handle *F* also admits air to the rear end of cylinder *G*, causing the jaw *C* to slide back and release the hose. The operation can then be repeated.

The air-valve arrangement by means of which the machine is controlled as described is rather interesting. The valve controlled by lever *E* admits air to all three cylinders *J*, *K*, and *G* when raised to the vertical position. Check valves *S*, with 1/16-inch holes drilled through their inside walls to admit air against their checks, serve to slow up the forward movement of the pistons which carry holders *A* and *B*. The piston in cylinder *G* advances at a more rapid rate than those of cylinders *J* and

through pipe *K*, which causes the clamping jaw *C* to slide back and release the work.

The average time required to remove the fittings from a lot of fifty old hose assemblies and apply them to new hose is approximately 3 hours 5 minutes, or an average of one complete steam hose in 3 minutes 42 seconds. When this work is done in the usual manner without special devices, the time is frequently as high as 15 to 20 minutes per hose. According to a time study taken under average conditions, the first operation, consisting of removing four 1/2-inch nuts and taking off the two-section malleable clamps from a lot of fifty hose, was 55 minutes. The time required to split each

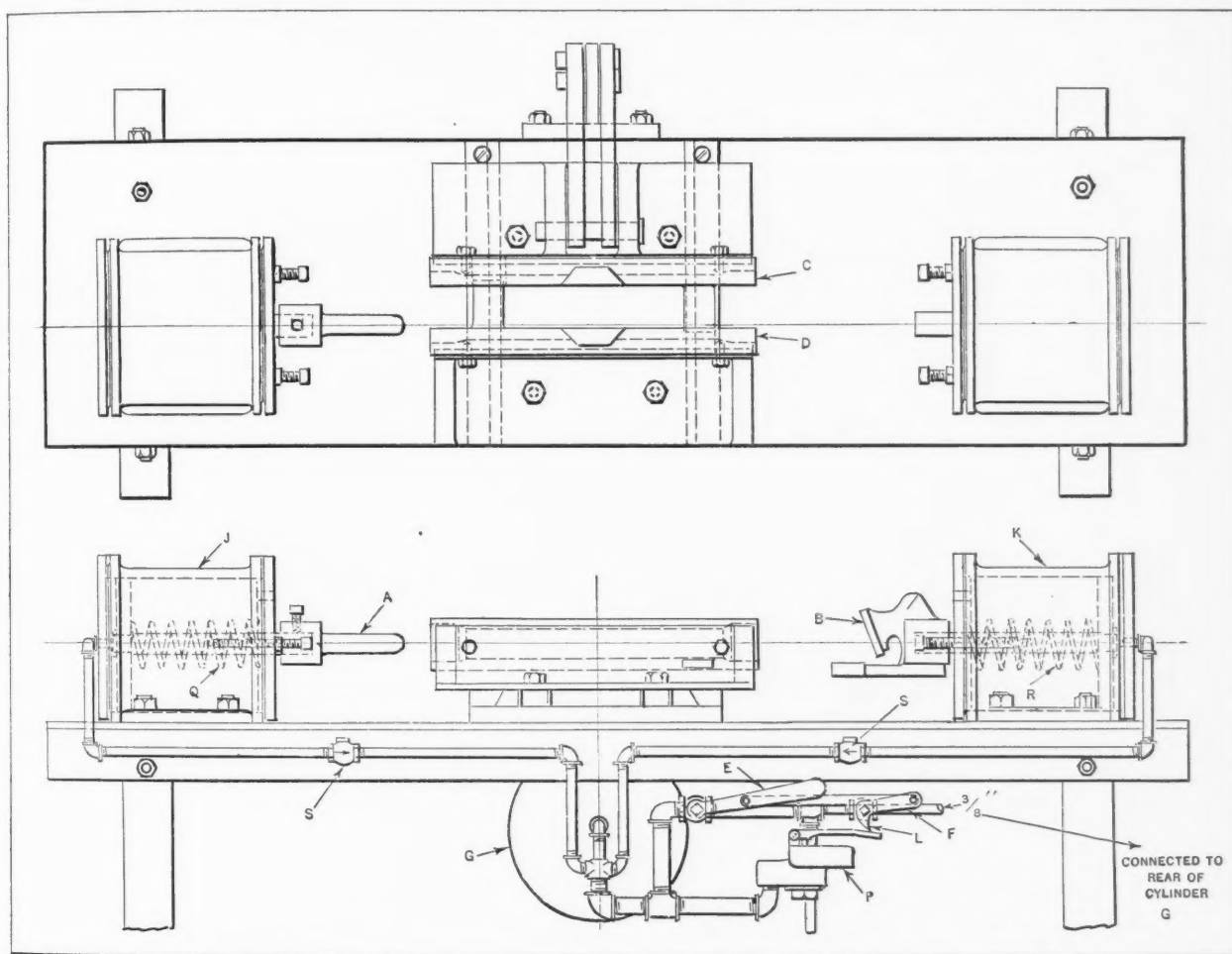


Fig. 7. Front and Plan Views of Machine Shown in Fig. 3

K, causing the clamping jaw to close before the fittings come in contact with the work.

When the operating lever *E* is moved to the vertical position to admit air to the three cylinders, as described, the valve lever *F*, which controls a three-way cock, is also in the vertical position and allows air to escape from the pipe *K*, Fig. 6, of cylinder *G*. The cam *L*, Fig. 7, welded to lever *F*, is also out of contact with the lever of release valve *P* when lever *F* is in the vertical position, so that valve *P* is closed. When both the operating lever *E* and the valve lever *F* are in the positions shown, the valve operated by lever *E* is closed, so that air from the pressure line is shut off, while the cam *L* on lever *F* holds the valve *P* open, so that the air can escape from all three cylinders. With the valve handle *F* in this position, the three-way cock which it controls is set to admit air to cylinder *G*, Fig. 6,

end of the fifty pieces of hose and remove the fittings was 15 minutes, while the time required for pressing in the new fittings, applying new clamps, and tightening the four bolts was 1 hour 55 minutes.

CHUCK FOR HOLDING LOCOMOTIVE VALVE RINGS

By E. A. LOTZ, Shop Foreman, Pennsylvania Railroad Co.

A quick-acting chuck for holding valve snap rings in the closed position while turning the outer surface to fit the valve cylinder is shown in the accompanying illustration. The chuck is used for turning new rings as well as for re-turning old ones of the type shown at *W*. It consists primarily of the faceplate member *A*, the slotted pin *B* secured to member *A*, the work-holding ring *C*, the clamp-

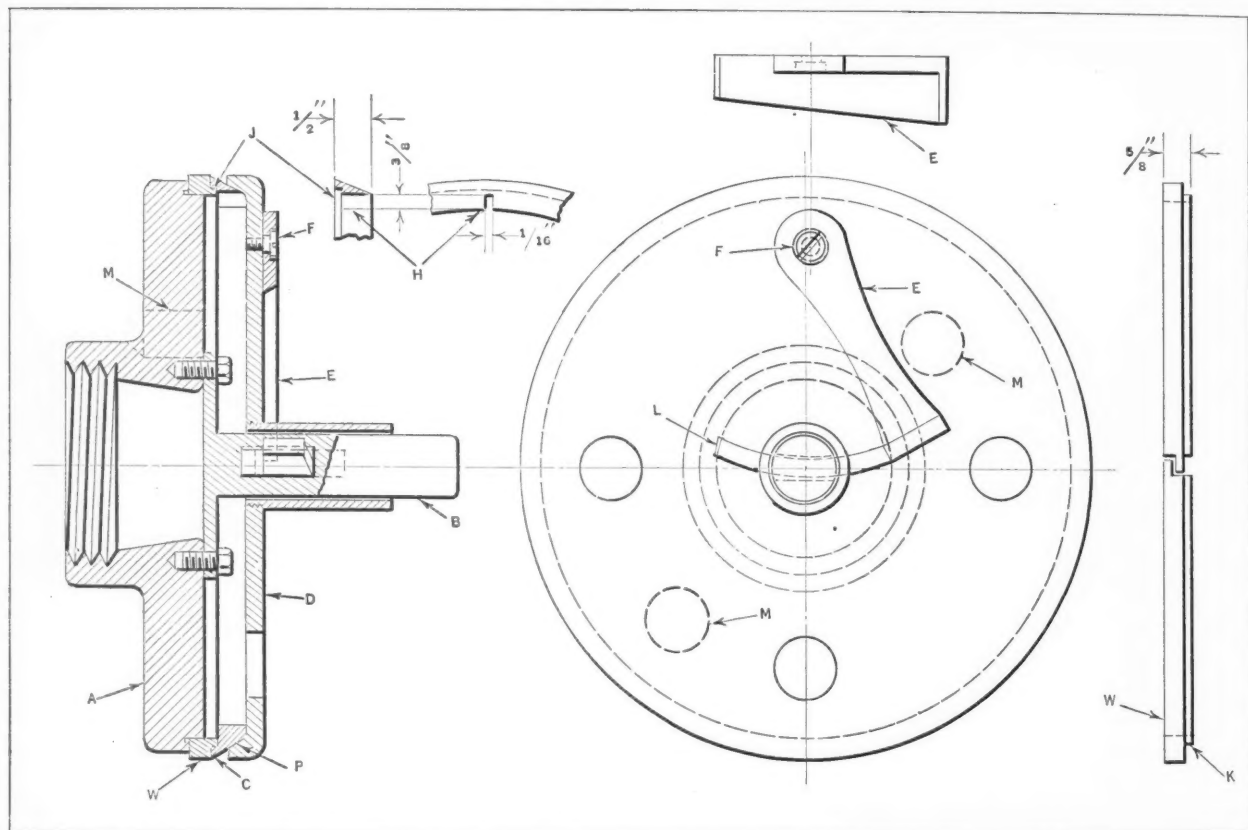
ing plate *D*, and the pivoted taper key *E* which swings about the pivot stud *F*.

Two work-holding rings like the one shown at *C* are provided, so that one can be loaded while the other is clamped in the chuck. These rings have three slots like that shown in the partial section views at *H*. The three slots are spaced 90 degrees apart, and the ring is cut completely through on the remaining quarter division. Thus ring *C* can be contracted so that the valve ring to be turned may be clamped in the closed position.

In loading one of the work-holding rings *C*, the lip *K* on the work is forced into the recess *J*. After the ring is turned to size, it is removed from the

mitted through a side opening in the furnace, is employed to heat the surface of the piston to be built up, to a temperature of about 1500 degrees F. During this operation, the piston is revolved in order to obtain uniform heating.

When the required temperature has been attained, the burner is removed and replaced by the "Metalayer" torch. The piston head is then revolved while metal is deposited by the torch. The lathe spindle is run at a speed which carries the surface on which the metal is deposited past the torch at the rate of 28 feet per minute, while the torch is fed along at the rate of 3/4 inch per revolution. With this speed and feed combination, a coating



Lathe Chuck Used in Turning Locomotive Valve Rings

chuck by driving out the wedge pin *E*, which pivots on stud *F*, and then withdrawing the clamping member *D* and ring *C*. Another holder *C*, with a new ring *W* in place, is then located on member *A*. The clamping plate *D* is placed on the slotted stud *B*, and the pivoted wedge *E* driven lightly into place. The wedge action thus obtained causes the conical surface *P* of plate *D* to contract the ring *C* and clamp the work securely to the plate *A*. Plugs can be inserted in the holes *M* to provide means for using a lever in removing the chuck.

BUILDING UP WORN PISTONS WITH A TORCH

By H. C. SYMANK, Blacksmith Shop Foreman,
Denver & Rio Grande Western Railroad Co.

The application of a "Metalayer" torch as described here has made it possible to build up a piston head in seven minutes, whereas twelve hours was required by the old method. The piston and the head to be built up are put in a lathe, and the head enclosed by a sheet-metal furnace having hinged sides. A high-pressure air oil burner, ad-

3/16 inch thick is applied. The "Metalayer" torch is connected with the shop acetylene and compressed air lines.

The torch contains a compact wire-feeding machine driven or operated by a small air turbine. This device feeds the wire through the nozzle of the torch at a rate varying from 12 to 24 feet per minute. The 20-gage copper or bronze wire fed through the nozzle of the torch is melted by the oxy-acetylene flame combined with the compressed air, which blows the atomized metal against the surface of the hot revolving piston head. The velocity of the atomized metal is about 300 feet per second. As the metal impinges against the surface at this high velocity it becomes solidified and welded to the piston head as an integral part.

* * *

The first definite start in the building of merchant vessels from steel, as a regular policy of steamship companies, was made in England fifty years ago; during the year 1878 eleven vessels were built from steel.

What MACHINERY'S Readers Think

Brief Contributions of General Interest are Solicited and Paid for

IS A STANDARD TAPER REQUIRED?

A great deal is being said and written at the present time about the adoption of a standard taper and taper shank for use in the machine shop field. A 3/4-inch taper per foot has been proposed, and many arguments have been presented in its favor. In view of the very general use of other standard tapers, especially Morse tapers, there is something to be said on the other side as well.

It is believed that it would be of great value to the industry if readers of MACHINERY would express their opinion briefly, in statements of not more than 100 words each, as to whether a standard taper should be adopted; and, if so, what standard would have the greatest advantages and would cause the least inconvenience in its adoption.

DESIGNERS SHOULD CONSULT OPERATORS

My attention was recently called to an article in April MACHINERY in which it is stated that an operator, during a period of twenty-seven years, was never consulted for suggestions or improvements that would, perhaps, promote the efficiency of machine tools. This, I believe, is quite an exception. To be frank, I will say that he has been unfortunate in being engaged where a real machine designer did not exist.

No successful machine designer would attempt to analyze and design a machine without first obtaining all the available information regarding the requirements to be met; to obtain this, the operator must be interviewed, together with many others. As a matter of fact, everyone who has any knowledge whatsoever of the requirements of the particular machine to be designed, should be interviewed, and all suggestions noted and carefully analyzed.

Cooperation is the keynote of successful designing today. The more prominent and the more intelligent a man becomes, the more he begins to realize how little he can do by himself. Here you have the secret of our successful leaders of today.

GEORGE T. CHAPMAN

The article "Designers Should Consult Operators" in April MACHINERY, page 575, reveals a situation which it behooves the industry to remedy. Foreman training has disclosed the value of having foremen visit other plants for the purpose of getting ideas which they can afterward apply to their own work. Modern industries, such as aircraft, unsteepped in tradition, take it for granted that the designing engineer should fly in the trial flights of the plane he has designed, in order to determine what changes and alterations seem to the pilot to be necessary, in actual operation. In fact, they usually send along an engineering representative when delivering a new plane, to provide the neces-

sary instruction and information with respect to its operation and characteristics, and incidentally to study the flying customer's ideas.

The machine tool industry is comparatively unfortunate, as there is often no opportunity for the designer to observe the machine under the purchaser's operating conditions. It would certainly be a worthwhile investment to encourage inspection tours for designers to operators' plants, to observe and gather data on actual operating conditions. These trips could be planned as are the now relatively well established foremen's inspection tours.

JOHN W. KAUL

LOWERING THE COST OF MAKING DIES

The editorial in February MACHINERY, "The Tool Engineer's Job," seems to me to be especially applicable to diemaking. There are die set manufacturers who, through quantity production, have made it possible to effect appreciable savings in the cost of making dies. Many die designers, however, still hold on to their own expensive punch and die-holder standards. Castings are requisitioned from the store-room and these, together with blueprints, are sent to the shop, where guide pins and bushings are machined and fitted to them. By the time the die is ready for assembly, the work done on a die set of average size may be about \$60. In a recent case, this amount was reduced to \$20 by purchasing a complete die set ready-made. Similar savings can be obtained by using hardened and ground dowel-pins made for the trade. The cost of stripper bolts or shoulder screws was reduced 90 per cent by buying them instead of making them in the shop.

Besides being cheaper, purchased die sets make it possible for the shop to devote its entire time to the die itself—a factor to be considered when a die is wanted in a hurry.

SAMUEL KAUFFMAN

INSTRUCTIONS FOR INSTRUCTORS

Adding to the discussion on "Instructions for Instructors," I think the strictly academic viewpoint should be carefully avoided in teaching engineering, because it often does not go back to real fundamentals. As an example of the breakdown of the academic viewpoint, I would cite a personal experience of a few years ago when I attempted to supplement my income by teaching drafting in the evening schools of New York City.

The examination offered the candidates had as one problem "Make a working drawing of a connecting-rod." There immediately arose to my mind a vague picture of a "standardized" locomotive connecting-rod that I had drawn in a New York City high school many years previously and one that I had afterwards seen in several exhibits of drawings at various other schools. To the man who prepared the examination questions that par-

ticular connecting-rod, through long years, had become a fixed idea. It symbolized the academic connecting-rod. From my acquired practical experience, I could easily have designed a connecting-rod for a given purpose, provided I had been given the requirements, but to remember "the" connecting-rod in all its details was hopeless. Undoubtedly, a recent graduate found this question easy, though to me—an experienced engineer—it was a hard one. This represents the academic viewpoint of attacking a problem such as drawing, rather than dealing with it from the fundamental conception of its use and purpose in the manufacturing process.

JAMES P. KEATING

ARE SERVICE REQUIREMENTS BECOMING EXCESSIVE?

The examples cited by "Machine Tool Manufacturer" on page 575 of April *MACHINERY* disclose a condition that is far from any practical conception of "reasonable," and that answers the question in the affirmative. I would draw the line in defining "reasonable" service between that which is provided free, incidental to the regular visit of the sales engineer to the purchaser's plant, and that which arises from specific request of the purchaser for immediate service.

If, in the course of his regular contact visits, or specific visits for other purposes, the sales engineer checks up on the machines, makes certain adjustments, and provides specific advice on the use of the machine for given purposes, that would, to my mind, be reasonable free service. If, however, the purchaser requests immediate service at any time, necessitating a special trip of the sales engineer or repair man, that is something the purchaser should be expected to pay for. The only exception that I would regard as reasonable under such circumstances would be if the trouble was definitely occasioned by a hidden flaw in the machinery or by a part that was obviously defective when the machine left the maker's plant. In such instances, I believe it reasonable for the machine manufacturer to make good to the purchaser without cost.

W. F. MICHAEL

EXPERIENCE VERSUS THEORY IN DESIGNING

I read with considerable interest the observations under the heading "Experience Versus Theory in Designing" on page 605 of April *MACHINERY*. In pointing out the importance to the draftsman in "getting started," he has touched on a point that cannot be over-emphasized. Long practical experience with draftsmen discloses two ways in which the two types of mind start their work. The student mind starts out by a full-scale lay-out of all the known factors, with additions of known or obvious details, before it even begins to tackle the fundamental problem of the real design. The practical mind starts out by making simple quick free-hand sketches of ideas—without dimensions, frills, or unimportant details—it goes after the big basic idea quickly. The student type of mind has not even begun to attack the real problem by the time the practical mind has evolved not only one but many possible solutions. Careful supervision can,

in most instances, convert the student type of mind into the practical type.

Letting a draftsman follow and maintain contact with his work through the shops is an extremely important factor in his ultimate development. In this way, the alert type of mind can often discover improvements that would not otherwise suggest themselves.

JOSEPH CHEESMAN

TOOL MANUFACTURERS' ASSOCIATION

An educational association of manufacturers engaged in the tool and die field is very much needed. At present, the competition in this field is utterly ruinous. Prices are quoted that have no relation whatever to the cost of producing the tools. In one case, the quotations submitted by tool manufacturers ranged from \$1900 to \$5900 for the same work. In that particular case, a careful estimate indicated that \$4000 was about right, and that lacking the ability to estimate the reasonable cost of the work, made some estimates entirely too low and others far too high.

Practically all tool work is now done on an estimate basis, and very little, if any, is done on a time basis. Too low bidding is so prevalent that whenever I get a contract I always have an uneasy feeling, thinking that I must have made a mistake and underestimated the cost, because otherwise I would not have obtained the order.

An association through which tool and die manufacturers could be educated gradually in the work of properly estimating the cost of tool work and of including in their estimates all legitimate expenses would be of great help to the industry as a whole. In the long run, it profits nobody to have the tool manufacturer lose money, because it hampers his ability to give good service. Other die and tool shops are invited to express their opinion as to the desirability of a die and tool manufacturers' association.

TOOL MANUFACTURER

LIABILITY FOR DEFECTIVE MACHINERY

Under the heading "Defective Machinery," on page 618 of April *MACHINERY*, the impression is given that an employer is not liable for accidents even when he or his duly authorized agent has been notified of the defective machine and fails to make the necessary repairs, provided it can be proved that the workman failed to exercise ordinary care in protecting himself against injury.

The courts may hold to this opinion, but I doubt if a jury would give a verdict in favor of the employer, because under the circumstances it would be almost impossible to prove that the employee did not use due care. While, theoretically, the court might not hold the employer liable, in practice a jury undoubtedly would.

In most states, a workmen's compensation law is in operation, and most employers of labor carry insurance in compliance with the provisions of these laws. If an employer is self-insured, he would be unwise not to take all possible precautions against defective machinery; if insured, the insurance company carrying the risk would not for a moment consider contesting a claim due to defective machinery.

W. T. CHARLES

LACQUER FINISH FOR PATTERNS

By R. M. FELLOWS, Fellows Gear Shaper Co., Springfield, Vt.

For years it has been the custom to apply several coats of shellac to all wood patterns. This helps to keep moisture out of the wood and to keep the glued joints tight so that the patterns will retain their shape better. It has been the experience of the Fellows Gear Shaper Co., Springfield, Vt., that shellac does not provide an entirely satisfactory protective coating. Enough coats are not usually applied when the pattern is new. The pattern is not removed from the foundry often enough to permit a new coating of shellac to be applied before the old coats have worn off. Moisture from the molding sand penetrates the shellac and reaches the wood, causing the grain to become raised and the glued joints to start to open. As a result, the pattern gets out of shape and will not produce a true casting. Also, shellac does not give a finish of sufficient smoothness to eliminate the necessity for frequent patching of the mold with hand tools. This patching often gives the casting a wavy appearance.

Core-boxes that are finished with shellac become caked from core oil, sand, etc., and, unless kept clean by the use of kerosene or something of this kind, the cores gradually decrease in size and add weight to the casting produced. After much experimenting and research work, we have adopted lacquer for all our standard patterns. In the latter part of October, 1927, several lacquer-covered patterns and wood plates were sent to the foundry to determine whether castings produced from them were more accurate than those produced with patterns coated with shellac. The reports from the molders and officials of the foundry were to the effect that the lacquer-covered patterns drew from the sand much better, did not tear the mold as much, and produced a much smoother casting.

After a few castings had been made from these wood patterns and plates, Northern New England was visited by a destructive flood which swept through the local gray iron foundry carrying away practically all our patterns and wood flasks. The lacquer-covered patterns and plates went with the rest. Some of these patterns, as well as some of the shellac-covered patterns, were found scattered along the banks of the river for three miles.

The glued joints of the shellac-covered patterns had either started to open or were all apart, and the shellacked wood plates were out of shape. Ninety per cent of all shellacked patterns had to be replaced before more castings could be made. The lacquered patterns were absolutely dry and the glued joints had not started to open at all, even though some of them were in the water for three days. The lacquered wood plates were absolutely straight, showing that no moisture had penetrated the lacquer. One particular metal pattern on a wood plate was half buried in mud, while the other half was under more than 6 feet of water for about thirty-six hours. After cleaning away the mud and silt from these patterns and plates, they were ready for use.

Experiments seem to indicate that a brushing lacquer gives more satisfactory results than a spraying lacquer. The brushing lacquer fills the

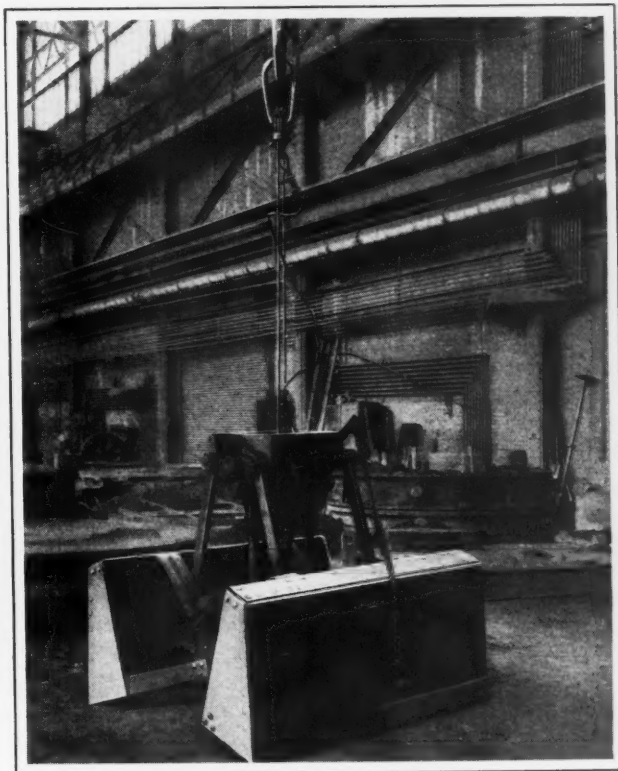
rough places in the pattern more evenly than the sprayed lacquer. Wax fillets, etc., should be shellacked over before applying the lacquer, as the lacquer does not harden properly on the wax and the molding sand will stick to it. A flood like the one mentioned, which happens about once in a lifetime, served to prove that lacquer keeps all moisture out of the patterns, while shellac does not. Shellacked patterns kept in a cool or cold pattern safe will gather considerable moisture, whereas lacquered patterns will not. Metal plates and patterns which have not been sherardized will rust from the moisture in the molding sand and the perspiration from the molder's hands. When lacquer is applied to the patterns, this trouble is eliminated.

The first cost of finishing a new pattern with lacquer is more than the cost of finishing with shellac. However, several hundred castings can be made from a lacquer-finished pattern without any change in the smooth, true shape of the castings produced. A shellacked pattern, on the other hand, must be refinished after producing fifty or sixty castings if satisfactory results are to be obtained. Considering all factors, it has been decided that lacquer is fully as cheap as shellac for finishing patterns and that its use results in smoother and more accurate castings.

* * *

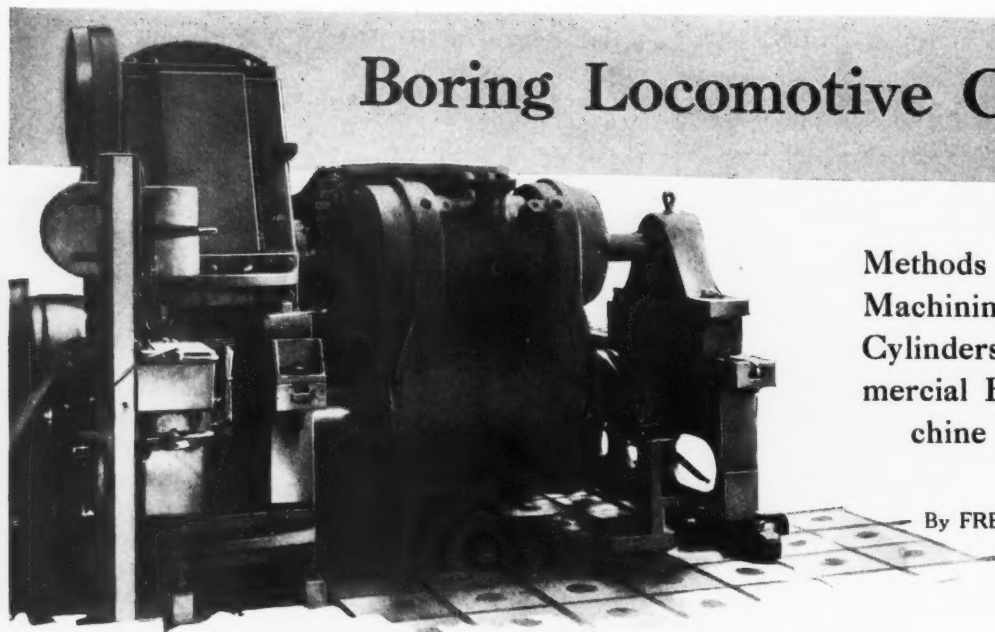
A CRANE CABLE SAFETY DEVICE

The accompanying illustration shows a safety cable device used in the gray iron foundry of the Erie Works of the General Electric Co. The safety device consists of an additional "idle" cable attached to the grab buckets shown. This cable is sufficiently heavy to check the fall of the supported weight in the event that the main supporting cables should break.



Safety Cable Device

Boring Locomotive Cylinders



Methods Followed in
Machining Locomotive
Cylinders on a Com-
mercial Basis in a Ma-
chine Tool Plant

By FREEMAN C. DUSTON

THE method of boring and facing locomotive cylinders described in this article represents the latest practice of the Shaw Crane-Putnam Machine Co., Inc., Putnam Machine Co. Works, Fitchburg, Mass. In addition to building a line of machine tools and special machines for railway shops, this company has for some years produced locomotive cylinders. This work was originally undertaken to assist the railway companies when production demands greatly exceeded the capacity of their shops. The service thus rendered proved so satisfactory that some railway companies have continued to employ it regularly.

The same machining methods are used for cylinder castings furnished by the railroads as for cylinders cast and machined complete in the plant of the Putnam Machine Co. Works, which is equipped for handling any kind of machine or railway work, from the production of small parts to the building of a complete locomotive or heavy machine tool for practically any kind of work.

The majority of cylinder castings produced by the company are made in molds of the dry sand pit type. A few, however, are made in molds produced in iron flasks and baked in an oven. In some cases, patterns are made in the company's pattern shop according to blueprints and specifications furnished by the railway company. Fig. 3 shows one type of cylinder regularly produced. The heavy black lines in the half-section portion of this illustration indicate the surfaces of the casting that are finished by boring, facing,

and turning on the machine shown in the heading illustration.

Design of Cylinder-boring Machine

The machine shown in the heading illustration is of rugged construction, and can be readily set up for boring and facing any type or size of locomotive cylinder. It consists primarily of three separate units, a headstock, tailstock, and work-bed. These three units are bolted to the floor plate, and are furnished with or without the floor plate, as required. Shops requiring new or additional cylinder-boring equipment need order only the three units referred to if sufficient floor-plate space is available.

Referring to Fig. 1, the tailstock base *B* supports the cylinder boring-bar *C* on which is mounted the boring head *D*. On base *B* is mounted the tailstock which supports the boring-bar *E*. On bar *E* is the boring head *F* employed in boring the valve chamber. After the work is in place, the boring-bars are pushed through the rough-cored hole to be finished, and their flanged ends *G* and *H* are bolted to the faceplates *I* and *J*, Fig. 2, of the driving spindles.

Separate motor drives are provided for the two spindles of the headstock. This makes it possible for the upper headstock and the upper tailstock members to be adjusted for height, as well as lateral position, to suit different cylinder-boring requirements, without interfering in any way with the cylinder spindle drive in the base of the headstock.

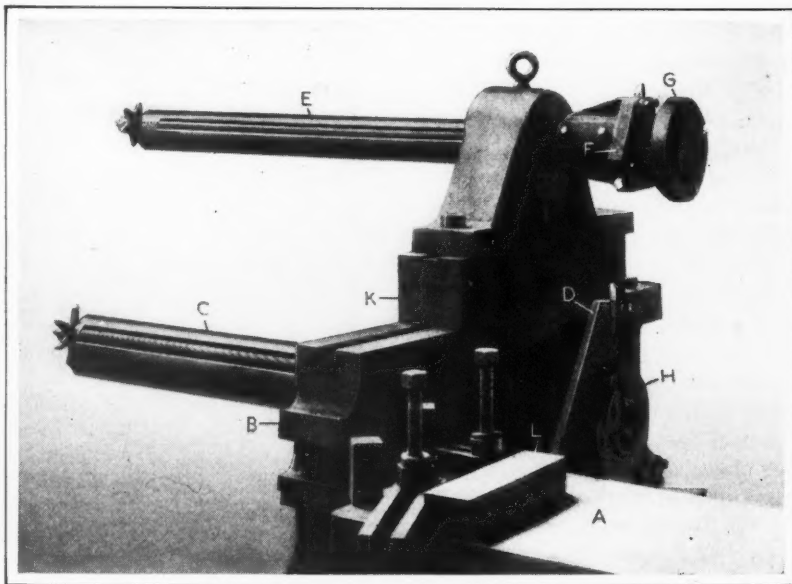


Fig. 1. Tailstock of Cylinder-boring Machine

Setting up the Cylinder-boring Machine

It is a simple matter to set up the machine for boring any type of cylinder. First, filler blocks, such as shown at *K*, Figs. 1 and 2, are placed under the upper headstock and tailstock members to bring the boring-bar *E* to the correct height above boring-bar *C*. The heads are then adjusted laterally to suit the dimensions specified for the particular class of cylinder to be bored. A complete set of properly marked filler blocks *K* for the various types of cylinders is kept on hand.

After the machine has been properly prepared, the cylinder casting is picked up by the traveling crane and lowered on the work-bed *A*. In some cases, filler blocks like the one shown at *L* are used on the top face of the work-bed and on its inner face to bring the cylinder casting into the correct position for boring. The surfaces *A* and *B*, Fig. 3, are planed before the cylinders are bored. The work is clamped in place by means of bolts and straps, such as shown in Figs. 1 and 2.

Micrometer length gages are employed in making the final setting of the upper bar to give the correct center distance between the boring-bars for the cylinder and the valve chamber. The position of the bars is also checked in some cases by measure-

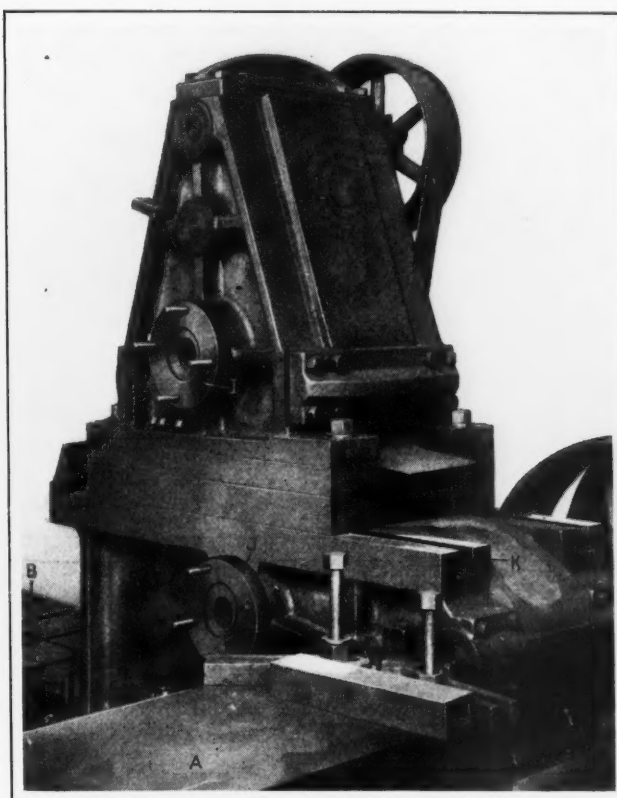


Fig. 2. Headstock which Drives Boring-bars Shown in Tailstock in Fig. 1

ments from a straight-edge clamped to the face of the work-bed. By locating the finished surfaces *A* and *B*, Fig. 3, of the casting on the machined surfaces of the work-bed or on accurately machined filler blocks placed on these surfaces, it is an easy matter to line up the casting properly.

After the cylinder is in place, the boring-bars are pushed into position and the flanged heads *G* and *H*, Fig. 1, are bolted to the faceplates *I* and *J*, Fig. 2. The boring operation on the cylinder is commenced first, using the boring head shown in Fig. 4. The workman first places one cutter in position and starts the boring cut. Then the machine is stopped and the bored surface used as a means for locating the

other two cutters employed in the boring head. The cutters shown at *E*, *F*, and *G*, Fig. 6, comprise the complete set for this rough-boring operation. These cutters are ground uniformly to fit the profile gage shown at *H*.

The feeding arrangement for the boring head consists of a feed-screw *A*, Fig. 4, a nut *B* secured to the boring head, and a star-wheel *C*, actuated by one, two, or three pins like the one shown at *D*. Pins can be inserted in all or any one of the three equally spaced holes, thus giving three rates of feed.

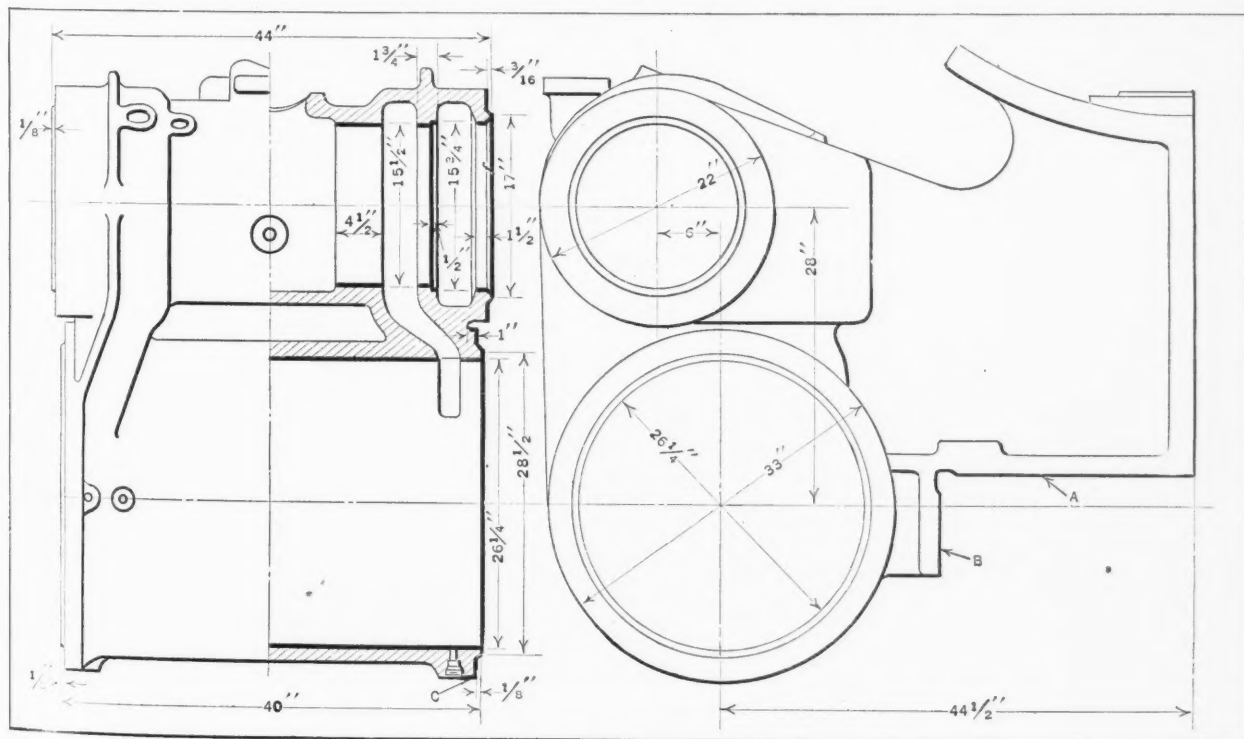


Fig. 3. Typical Locomotive Cylinder Bored on Machine Shown in Heading Illustration

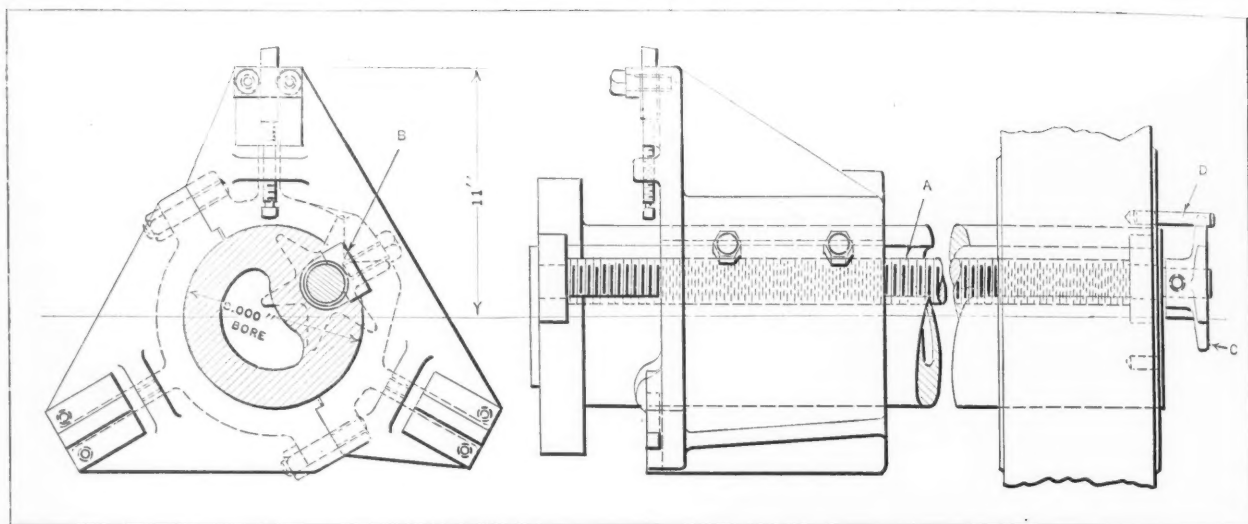


Fig. 4. Boring-bar and Head Used in Boring Locomotive Cylinders

The finest feed is, of course, obtained by employing only one pin.

As soon as the boring operation is under way on the cylinder, the cutters are placed in the boring head on the small bar and the boring operation on the valve chamber commenced. This operation is generally completed before the roughing cut in the cylinder is finished. Referring to Fig. 3, the heavy black lines in the half-section view indicate the surfaces machined. It will be noted that there are two different diameters to be finish-bored in the valve chamber.

Three cutters are employed for taking the first two boring cuts in the cylinder and in the valve chamber, but for the last or finishing cuts, only one cutter, like that shown at *D*, Fig. 6, is used. This cutter produces a smooth mirrorlike finish. Calipers set to size by micrometer gages are used in gaging the diameters of the bores. The boring-bars rotate in a right-hand direction, the same as the ordinary lathe spindle.

Facing Operations on the Cylinders

As soon as the bores are finished, the boring tools are removed from the heads, which remain on the boring-bars with the feed disengaged. The facing

heads are then clamped in place, as shown in the heading illustration. One of the facing heads for the cylinder is shown in Fig. 5. These heads are made in right- and left-hand designs. One end of the cylinder and the opposite end of the valve chamber are faced simultaneously.

The facing operations are completed by one roughing and one finishing cut. The tool is fed outward until the face, indicated by the 28 1/2-inch diameter dimension, Fig. 3, has been finished, after which the tool is fed in to give the required 1/8-inch shoulder depth, and the outward feeding movement is continued. For this operation, a tool like the one shown at *C*, Fig. 6, is employed.

The required feeding movement of the facing head tool-holder *A*, Fig. 5, is obtained by means of a star-wheel secured to the feed-screw *B*. The facing heads, with the star-wheels in place, are shown in the heading illustration. These wheels are turned a slight amount at each revolution of the boring-bars as a result of coming in contact with bars clamped to the machine frame or to an angle-iron bolted to the floor plate.

After completing the facing operations, the outer ends of the cylinder at *C*, Fig. 3, are turned, with tools like the one shown at *B*, Fig. 6. When the

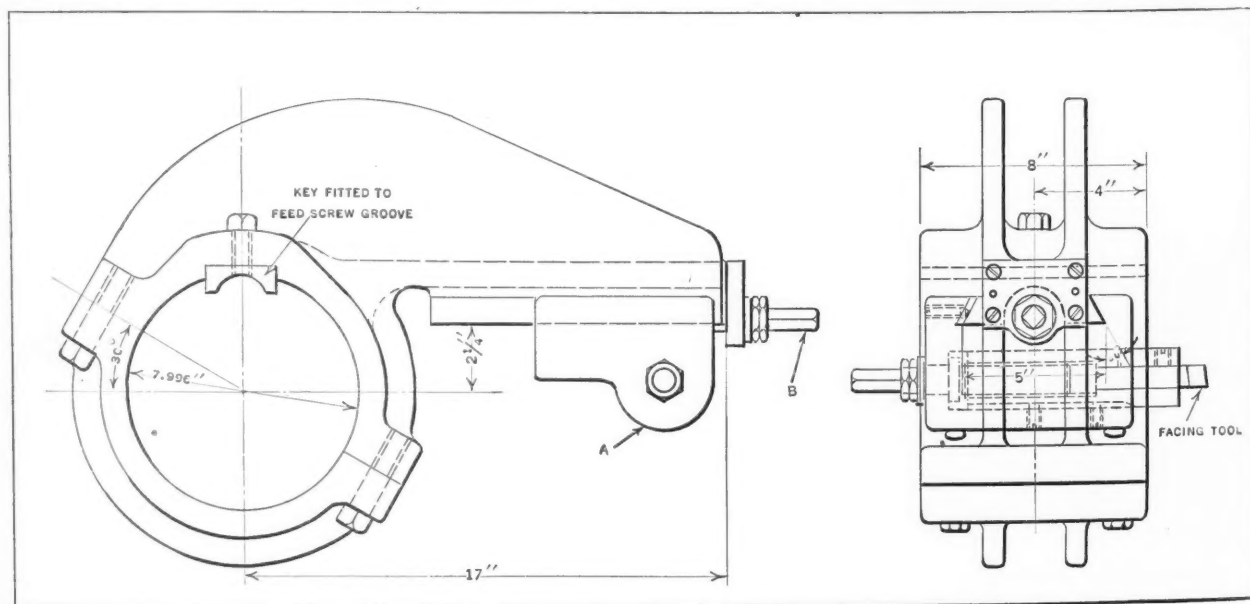


Fig. 5. Facing Head Shown Mounted on Lower Boring-bar in Heading Illustration

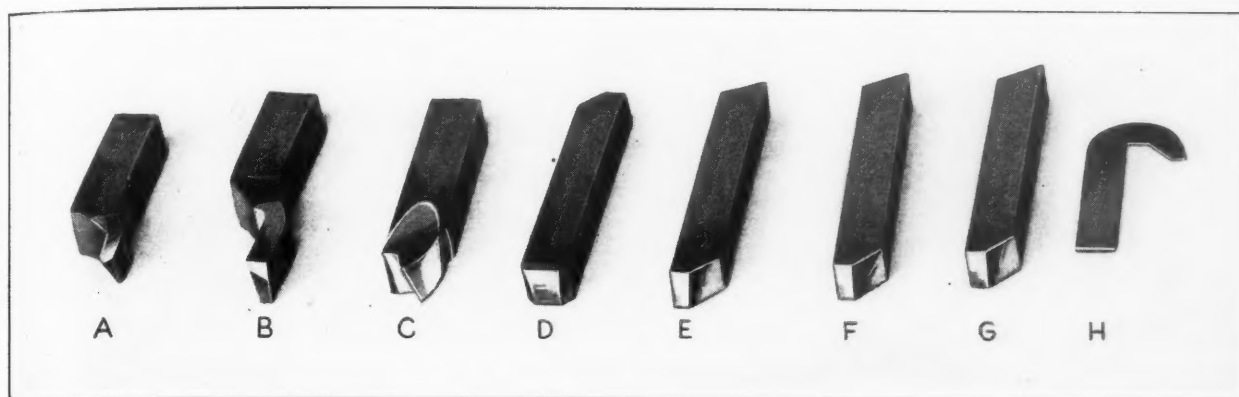


Fig. 6. Set of Tools Used in Boring, Facing, Turning, and Bolt-circle Marking Operations on Locomotive Cylinders

boring, facing, and turning operations have been completed with the facing heads located as shown in the heading illustration, both heads are removed and similar ones of the opposite hand secured to the boring-bars at opposite ends of the cylinder. The remaining faces are then finished in the same manner. In some cases, the bolt circles for the cylinder and valve heads are scribed or marked on the finished ends of the cylinder with a tool like the one shown at A, Fig. 6, which is held in the facing tool-holder.

Boring-bar Drives

The boring-bars have individual motor drives. The lower or cylinder boring-bar is driven by a 10-horsepower motor, running at 1200 revolutions per minute. The 36-inch drive shaft pulley A, Fig. 7, is driven by a belt from a 6-inch pulley on the motor shaft. Shaft B, on which pulley A is mounted, drives the cylinder boring-bar at a speed of 5 revolutions per minute through gears C, D, and E, the latter pinion meshing with the gear F secured to the boring-bar head.

The upper or valve chamber boring-bar is driven by a 7 1/2-horsepower motor equipped with a 6-inch pulley connected by belt with the 20-inch pulley G. The shaft on which this pulley is mounted

transmits power to the upper boring-bar through gears as indicated, which give the boring-bar a speed of 11 revolutions per minute.

Machining Time

The accompanying table gives some idea of the time required to complete the machining operations on piston valve cylinders like the one shown in Fig. 3. Even better machining rates are shown by some of the later time sheets, and it is safe to say that the average time now required in boring, facing, and turning this particular type of cylinder is thirteen hours.

It will be noted that the total machining time given in the last column of the time sheet includes the time required in subjecting the finished cylinder to a hydraulic test. The testing time includes that spent in fitting, packing, and bolting heads and plates in place preparatory to connecting the cylinder with the high-pressure water supply. The pressures employed range from 250 to 275 pounds per square inch.

Some other types of cylinders on which the machining times are fairly well established are the 19- by 28-inch piston valve cylinders which ordinarily require about fourteen hours for boring; the 20- by 30-inch, requiring about sixteen hours; the

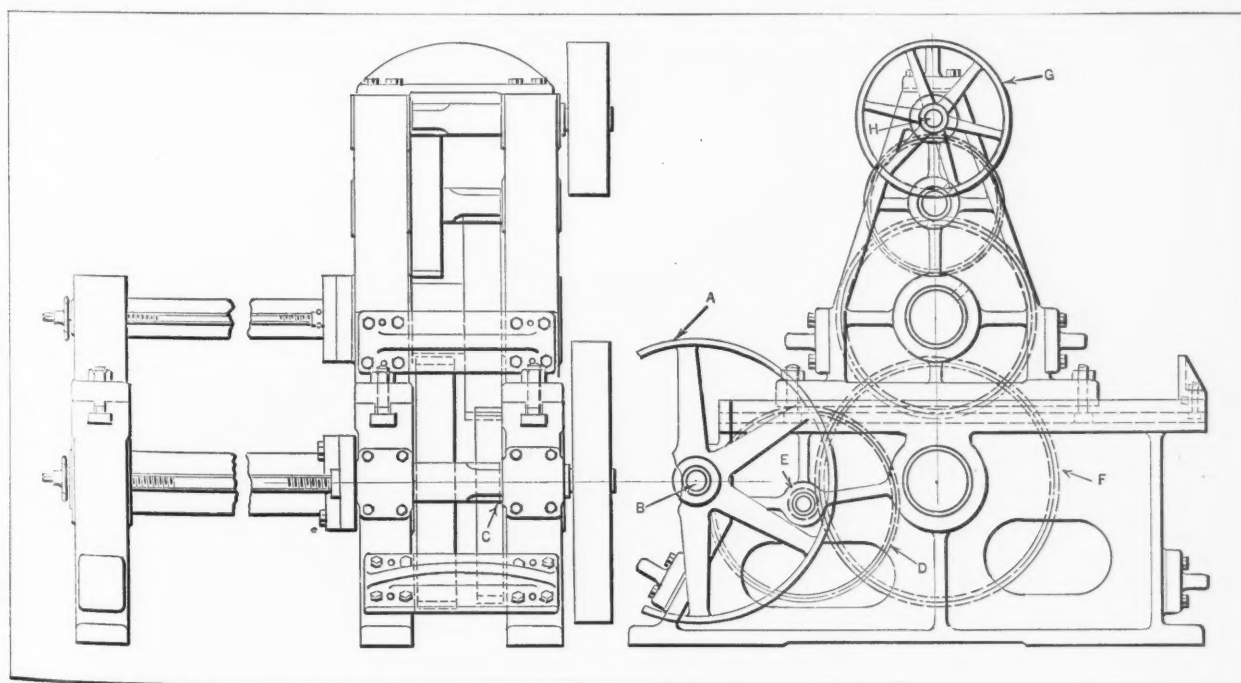


Fig. 7. Assembly of Cylinder Boring Machine

Typical Shop Record Sheet Showing Machining Time on Locomotive Cylinders

Class	Stroke	Average Weight	Shop Order	Quantity	Ordered	Completed	Average Number of Hours for One Cylinder				
							Planing Splice, Frame Fit and Ends	Bore	Drilling All Holes Except Frame and Arch Bolt Holes	Hydraulic Test	Total
Piston Valve	25 by 28	8325	33987	2	11/4/25	11/21/25	7.45	21.30	12.48	11.30	53.33
Piston Valve	25 by 28	8325	34062	2	11/19/25	12/8/25	8.51	16.15	13.12	11	49.18
Piston Valve	25 by 28	8325	34076	2	11/28/25	12/24/25	7.45	15.30	13.45	8.15	45.15
Piston Valve	25 by 28	8325	34271	2	1/27/26	2/5/26	7.33	12.51	12.39	11.54	44.57

Machinery

22- by 28-inch, requiring about seventeen hours, and the 23- by 28-inch, requiring about nineteen hours.

Slide valve type cylinders of the 19- by 26-inch size are regularly bored and faced in from 6 1/2 to 8 hours. The time required for boring practically any type of slide valve cylinder comes within a range of 6 to 9 hours.

* * *

CHUCK FOR THIN-WALLED SHELLS

By B. J. STERN

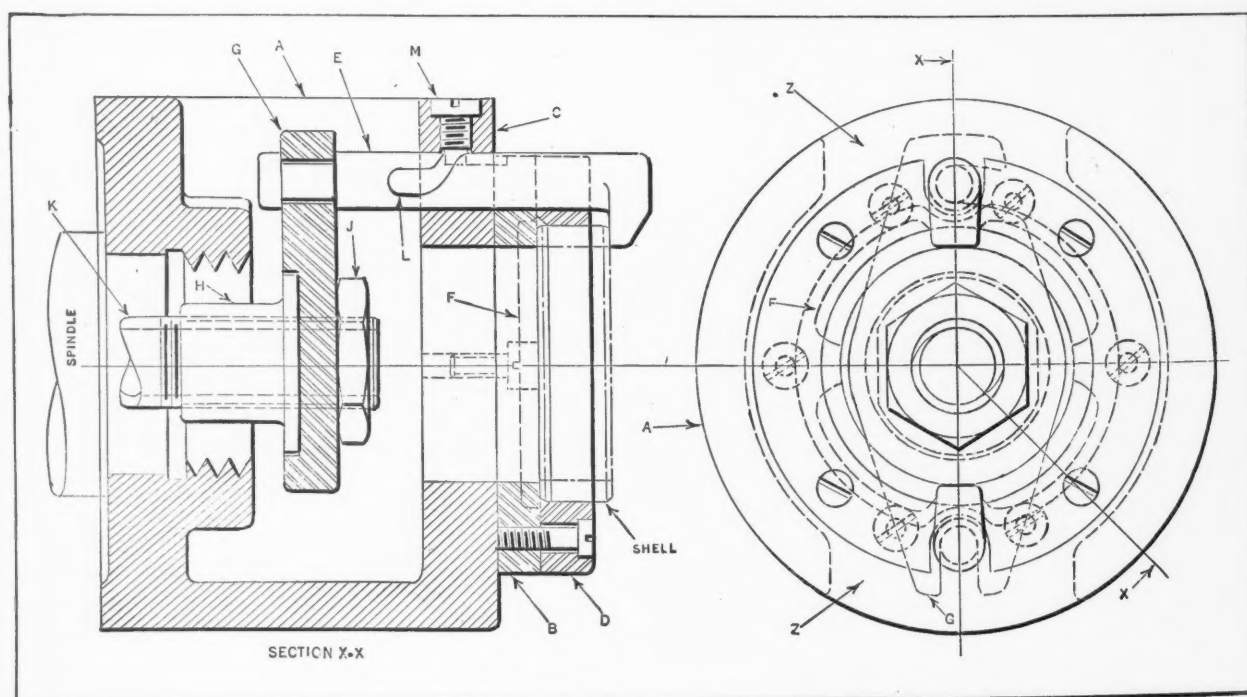
It was required to grind the inside diameter of a thin-walled steel shell to very close limits, and strict concentricity with the outside diameter was necessary. Gripping the shell on the outside diameter was tried, but this caused a slight springing that prevented the required accuracy. Finally, the chuck shown in the accompanying illustration was designed for the job.

The shells were made from tube stock in a four-spindle automatic machine. The operation consisted of turning the outside diameter to close limits, finishing and chamfering the face, rough-turning, and cutting off. After the machining operations, the shell is hardened.

The cast-iron body A of the chuck is threaded to

fit the spindle of the grinding machine. A hardened and ground backing plate B is screwed to the finished face C of the chuck body, there being a hole through the body and plate slightly larger than the required inside diameter of the shell. The face of the backing plate is relieved at F, giving four spots for the work to rest against. A hardened and ground nest D is screwed and doweled to plate B, centralizing the work with the grinder spindle. Two chuck fingers E, which pass through the chuck body and the rings cut out to clear these fingers, have L-shaped projections at the outer ends. These fingers are assembled to the spider G, which is slotted at the ends to fit in the grooves of the fingers. The body casting A is cored at Z to provide hand-holes for assembling. Spider G fits over the threaded bushing H, which is screwed on the draw-rod K. The check-nut J clamps the spider in the desired position. Draw-rod K is moved back and forth by the usual lever and spring action controlled by a handle convenient to the operator.

To provide clearance for unloading and loading the chuck, it is necessary to turn the projecting chuck finger ends out of the way. This is done by means of the dog-point screw M, which engages spiral grooves in the chuck fingers and thus turns the fingers as they are moved forward.



Grinding Chuck for Holding Thin-walled Shells without Distortion

TENTATIVE AMERICAN STANDARD BOLT HEADS—1

ROUGH AND SEMI-FINISHED SQUARE AND HEXAGONAL
REGULAR BOLT HEADS

Diameter of Bolt (All dimensions in inches)	Width Across Flats		Minimum Width Across Corners		Height	
	Maximum	Minimum	Hex.	Square	Nominal	Maximum Minimum
1/4	0.2500	3/8 0.3750	0.363	0.414	11/64	0.138 0.156
5/16	0.3125	1/2 0.5000	0.494	0.552	13/64	0.230 0.186
3/8	0.3750	9/16 0.5625	0.544	0.620	1/4	0.268 0.232
7/16	0.4375	5/8 0.6250	0.603	0.687	19/64	0.318 0.278
1/2	0.5000	3/4 0.7500	0.725	0.827	21/64	0.348 0.308
9/16	0.5625	7/8 0.8750	0.847	0.963	3/8	0.396 0.354
5/8	0.6250	15/16 0.9375	0.906	1.033	27/64	0.444 0.400
3/4	0.7500	1 1/8 1.1250	1.088	1.240	1/2	0.524 0.478
7/8	0.8750	1 1/4 1.2500	1.269	1.447	19/32	0.620 0.568
1	1.0000	1 1/2 1.5000	1.450	1.653	21/32	0.684 0.628
1 1/8	1.1250	1 5/8 1.6875	1.631	1.859	3/4	0.780 0.720
1 1/4	1.2500	1 7/8 1.8750	1.813	2.067	27/32	0.876 0.812
1 1/2	1.5000	2 1/4 2.2500	2.175	2.480	1	1.036 0.964
1 3/4	1.7500	2 5/8 2.6250	2.538	2.893	1 5/32	1.196 1.116
2	2.0000	3 3/8 3.3750	2.900	3.308	1 11/32	1.388 1.300
2 1/4	2.2500	3 7/8 4.1250	3.263	3.720	1 1/2	1.548 1.452
2 1/2	2.5000	4 1/8 4.1250	3.625	4.133	1 21/32	1.708 1.604
2 3/4	2.7500	4 1/2 4.5000	3.988	4.546	1 53/64	1.885 1.773
3	3.0000		4.350	4.959	3	2.060 1.940

Formulas

Width across flats of rough and semi-finished regular bolt heads shall be $1\frac{1}{2}D$ (D = bolt diameter) with adjustments in the sixteenth inch sizes to eliminate thirty-second inch size wrench openings.

Tolerance for width across flats shall be minus 0.050D.

Minimum width across rounded corners of hexagon equals 1.14 times minimum width across flats.

Minimum width across rounded corners of square equals 1.373 times minimum width across flats.

Height of head shall be $2/3D$. Tolerance for height of head shall be $0.032D + 0.024$.

The top of the bolt head shall be flat and chamfered; angle of chamfer with top surface shall be 30 degrees; diameter of top flat circle shall be 100 per cent of the nominal width across flats.

Tolerance on diameter of top flat circle shall be minus 15 per cent.

Rough and semi-finished regular bolt heads shall be at right angles to the body within 3 degrees and shall be concentric with the body within a tolerance of 3 per cent of the distance across flats.

Width across flats shall be measured at the bottom of the bolt head. Taper of sides of bolt heads shall not exceed 4 degrees.

MACHINERY'S Data Sheet No. 131, New Series, June, 1928

TENTATIVE AMERICAN STANDARD BOLT HEADS—2

FINISHED SQUARE AND HEXAGONAL BOLT HEADS

Diameter of Bolt (All dimensions in inches)	Width Across Flats		Minimum Width Across Corners		Height	
	Maximum	Minimum	Hex.	Square	Nominal	Maximum Minimum
1/4	0.2500	7/16 0.4375	0.428	0.588	3/16	0.194 0.180
5/16	0.3125	9/16 0.5625	0.552	0.758	15/64	0.242 0.227
3/8	0.3750	5/8 0.6250	0.613	0.843	9/32	0.289 0.273
7/16	0.4375	3/4 0.7500	0.737	1.012	21/64	0.337 0.319
1/2	0.5000	13/16 0.8125	0.799	1.097	3/8	0.385 0.365
9/16	0.5625	7/8 0.8750	0.861	1.182	27/64	0.433 0.411
5/8	0.6250	15/16 0.9375	0.922	1.266	15/32	0.481 0.457
3/4	0.7500	1 1/8 1.1250	1.108	1.521	9/16	0.576 0.549
7/8	0.8750	1 1/4 1.2500	1.293	1.775	21/32	0.672 0.631
1	1.0000	1 1/2 1.5000	1.479	1.886	3/4	0.768 0.723
1 1/8	1.1250	1 5/8 1.6875	1.665	2.031	27/32	0.863 0.824
1 1/4	1.2500	1 7/8 1.8750	1.850	2.246	15/16	0.959 0.916
1 1/2	1.5000	2 1/4 2.2500	2.222	2.533	1 1/8	1.100 1.051
1 3/4	1.7500	2 5/8 2.6250	2.593	2.956	1 1/16	1.284 1.234
2	2.0000	3 3/8 3.3750	2.964	3.379	1 1/2	1.468 1.403
2 1/4	2.2500	3 7/8 4.1250	3.335	3.803	1 11/16	1.651 1.585
2 1/2	2.5000	4 1/8 4.1250	3.707	4.226	1 7/8	1.915 1.835
2 3/4	2.7500	4 1/2 4.5000	4.078	4.649	2 1/16	2.108 2.019
3	3.0000		4.449	5.072	2 1/4	2.298 2.203

Formulas

Width across flats of finished hexagonal bolt heads shall be $1\frac{1}{2}D$ (D = diameter of bolt) except as follows:

1/4 to 9/16 $1\frac{1}{2}D + 1/16$

with adjustments in the sixteenth inch sizes to eliminate thirty-second inch size wrench openings.

Tolerance for width across flats shall be minus $(0.015D + 0.006)$.

Height of heads from top of head to under side of washer face shall be $3/4D$. Tolerance for height of heads shall be $0.030D + 0.005$.

Minimum width across rounded corners of hexagon equals 1.14 times minimum width across flats.

Minimum width across rounded corners of square equals 1.373 times minimum width across flats.

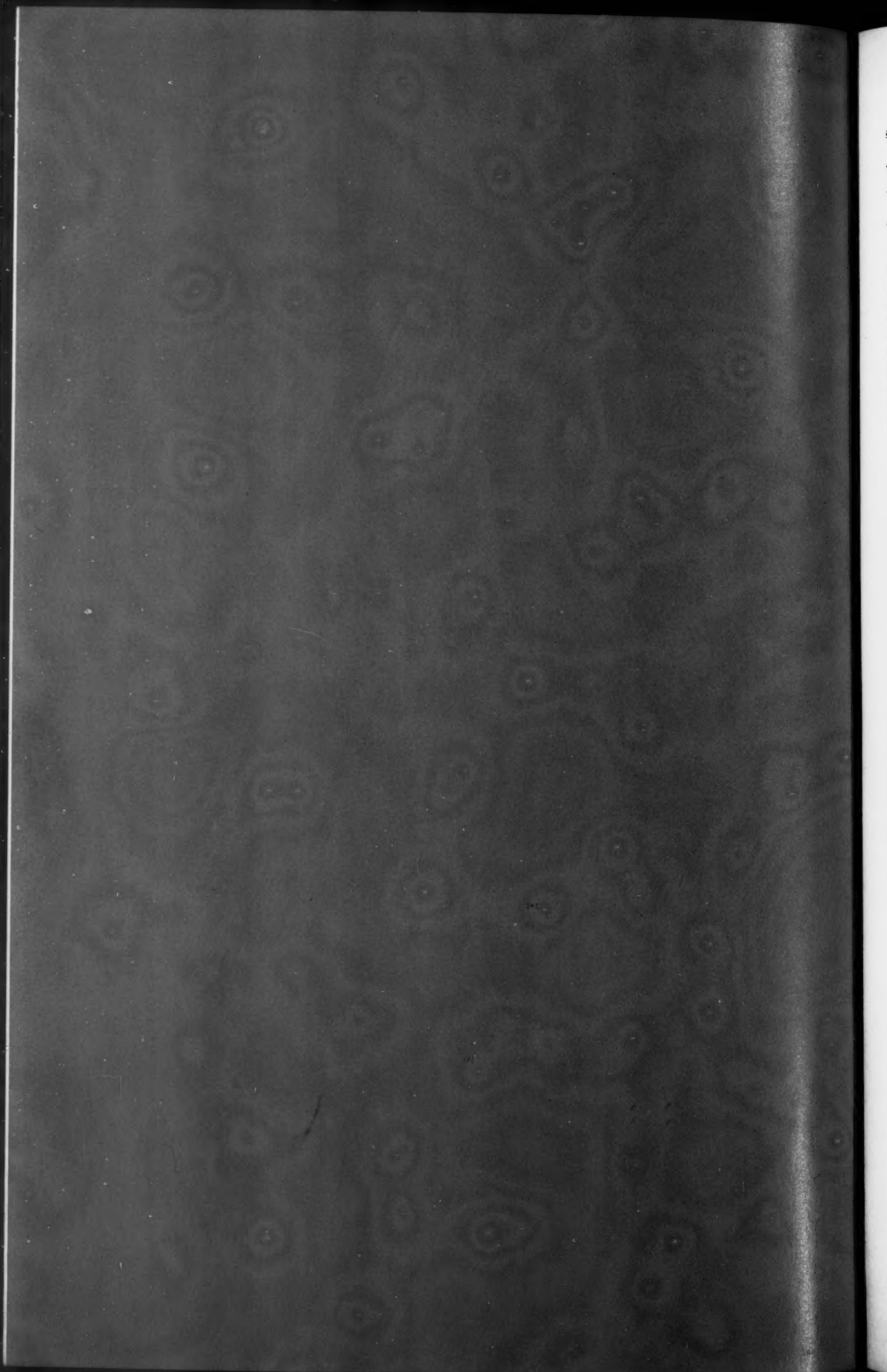
The finished top shall be flat and chamfered; angle of chamfer with top surface shall be 30 degrees; diameter of top flat circle shall be 100 per cent of the nominal width across flats.

Tolerance on diameter of top flat circle shall be minus 15 per cent.

Finished bolt heads shall be at right angles to the body within 2 degrees and concentric with the body within a tolerance of 3 per cent of the distance across the flats.

All finished bolts shall be washer faced, the height of the bolt head shall be the distance from top of head to the bearing surface. The thickness of washer face shall be $1/64$ inch. The bearing surface of washer face shall be 100 per cent of the nominal width across flats with a plus or minus tolerance of 5 per cent.

MACHINERY'S Data Sheet No. 132, New Series, June, 1928



Notes and Comment on Engineering Topics

Recently a mine in the Middle West was faced with the problem of installing a vertical pipe line to remove water 2200 feet below the surface. Pumping against this enormous head meant that the lower portion of the piping would be subjected to a pressure of nearly 1000 pounds per square inch. This pipe line was produced by welding together 100-foot sections, and placing flanges on the ends of each section which were screwed and welded to the pipe. The flanges were then screwed together to form the total pipe line.

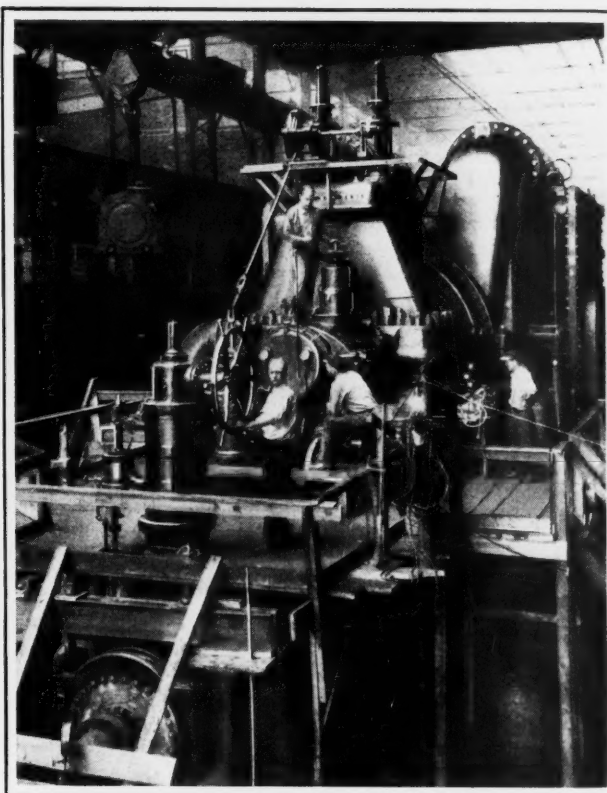
At a recent meeting of the Milwaukee Section of the Society of Automotive Engineers, James B. Fisher of the Waukesha Motor Co., stated that on a recent trip to Europe he saw a helicopter rise vertically from the Croydon Flying Field in England; this is said to be the only successful airplane of this type in the world. Its propeller seemed to be about 20 feet in diameter, revolving comparatively slowly. The present design of this airplane did not appear practicable, but it is interesting to note that a plane has been developed which will rise vertically and which can then be directed the same as an ordinary airplane.

The Diesel engine is making inroads in almost every field. For a long time steam engines were thought to be the only suitable motive power for oil-well drilling. At the present time, oil wells are drilled successfully with gas, gasoline, and oil engines, as well as with electric motors. It is only recently, however, that the multi-cylinder Diesel engine has been built in sizes small enough to be suitable for use in drilling oil wells and having the necessary degree of portability; but such engines are now available in four- and six-cylinder units. The problems to be solved in connection with the adaptation of the Diesel engine to oil field service were first to produce a high-speed engine of this kind without excessive weight per horsepower; and, second, to give the Diesel engine the same flexibility as is obtained with a steam-driven outfit. Fairbanks, Morse & Co. have recently produced a Diesel engine for oil-well drilling to meet the requirements mentioned. It is estimated that the

four-cylinder unit is applicable to depths up to 3000 feet, and the six-cylinder engine for greater depths.

It is of interest to note that the St. Louis Aircraft Co. advertises that it is prepared to furnish aerial taxi service from St. Louis to any other city in the country. The service is rendered by biplanes accommodating one or two passengers. Suitable outer flying garments are furnished to the passengers. The prospective traveler merely calls the

Aircraft Co. on the 'phone from his hotel, and a cab calls for him, taking him to the flying field, where the airplane is ready. The rates are 40 cents per mile, air distance, for one-way flights. Should the passenger want to return, the return trip is figured at only 5 cents per mile. An additional passenger is also carried at only 5 cents per mile, both for the going and the return trip. The Air Taxies, Ltd., of England, has maintained a similar service for some time, carrying passengers from London to any city in Europe on two hours' notice.



Testing a 94,000-kilowatt Steam-turbine-generator at the General Electric Co.'s Plant. This Giant Turbine-generator was Built for the Southern California Edison Co.

The largest electric tramway ever built in this country is to be erected by the Michigan-California Lumber Co. It will carry lumber across the canyon

at Camino, California, a distance of over half a mile. A single tram-carrier will convey a rail car, loaded with up to 12 tons of sawed lumber, 2700 feet between the terminals across the canyon, which is 1200 feet deep. The maximum speed of operation will be 1800 feet per minute, or at the rate of a little over 20 miles per hour. Four steel cables, each 2 inches in diameter, support the tram-carrier, which runs on thirty-two wheels. The electric equipment for the operation of the tramway has been built by the General Electric Co., consisting principally of two 225-horsepower hoist motors with a single manually operated master controller. The motors are geared to two large sheaves, each 8 feet in diameter, which engage an endless traction rope, 1 inch in diameter. Momentarily the two motors are able to exert a combined output of 800 horsepower, which will be required for short periods.

Current Editorial Comment

In the Machine-building and Kindred Industries

A SMALL BUT IMPORTANT LINK

The total investment in our steam railroad properties exceeds \$23,000,000,000, of which about \$700,000,000 represents the investment in railroad repair shops, including land, buildings, equipment and machinery. No exact figures are available giving the value of the machine tool equipment alone, but it has been estimated that about 25 per cent of the railroad shop investment is in machinery, representing a value of about \$175,000,000. This investment, then, is considerably less than 1 per cent of the total investment in all railroad property.

Because shop equipment represents so small a percentage of the total investment of the railroads, its importance has been minimized. The railroad shop is only one link in a long chain, and it has been called a small link, at that, when compared with the importance of the permanent way, the signalling system, the terminal facilities, the train dispatching system, and the rolling stock. This is true when measured by the cost in dollars and cents, but it is a link without which the whole chain of railroad operation would become useless, for a perfect permanent way, a faultless signalling system, ample yards and fine terminals, and an efficient train dispatching system are of little value if the rolling stock, for the movement of which all of these facilities are provided, is not kept in good condition by adequate shop equipment.

The cost of maintaining the rolling stock is over 28 per cent of the total operating expenses of the railroads. If this figure can be reduced by only a small percentage, the saving to the railroads will run into tens of millions of dollars annually. Improved shop equipment will aid in reducing this maintenance expense and will earn big dividends.

The railroad repair shop may be but a small link in the chain of transportation; but it is a very important link, and the men who have charge of these shops need the best equipment possible for carrying on their work efficiently and economically.

* * *

DON'T BLAME THE CUTTERS WHEN THE FIXTURES ARE AT FAULT

Manufacturers of milling cutters frequently receive complaints from users that their cutters do not produce a smooth surface, when investigation shows that the fault is with the milling fixtures, which are not designed sufficiently strong and rug-

ged to withstand the pressure of the cut. One of the most important factors in successful milling, next to the use of a machine of modern design capable of driving the cutter to its capacity, is the use of heavy fixtures that will not permit the piece operated upon to spring away from the cutter when the feed pressure is applied.

Frequently it is necessary for the cutter manufacturer to suggest an improved design of fixture, as otherwise the cutters will be blamed for the failure to produce smooth surfaces or a satisfactory volume of output. Users sometimes shop

around from one cutter manufacturer to another, complaining that they are unable to obtain satisfactory tools, until some cutter manufacturer questions the fixture equipment used with the cutter. Upon redesigning the fixture, it is often found that cutters from any well-known milling cutter maker will give satisfactory results.

* * *

GOVERNMENTAL- INDUSTRIAL COOPERATION

The Department of Commerce, since its reorganization in 1921 by Secretary Hoover, has afforded American industries the means of studying and solving industrial problems by the co-operative effort of industrial leaders and government officials. This is done through advisory committees of representative

men in the industries who take part in joint conferences with representatives of the Department of Commerce. There are now nearly 350 such committees cooperating with the department, which have held some 1400 conferences during the last six years.

Not less than eighty of these committees cooperate directly with the Bureau of Standards and 125 with the Division of Simplified Practice. The machine tool industry has cooperated through a committee on foreign trade. In the automotive field there are nine cooperating committees, and in the transportation field, four.

These committees bring the viewpoint of their industries to the Department of Commerce and return to them with stores of information brought out by the discussion of industrial problems in which the government is concerned. This is the first time in the history of the nation that it can be said that the government and industry have directly cooperated in the solution of industrial problems.

Importance of Machine Shop Equipment in Economical Railroad Operation

By J. M. DAVIS, President, Delaware, Lackawanna & Western Railroad Co.

IN former days, in many instances at least, a stroll through a railroad machine shop gave evidence of the fact that such an appurtenance to a railroad was regarded more or less in the light of a necessary evil. In other words, it was a customary adjunct. Every important railroad had one or more of them located along its lines. When locomotives and cars required repairing, they were sent to the shop. When they came out of the shop, they went back into service. No particular importance was attached to the operation.

Like many other practices, this policy has been outlawed on most roads. Particularly is this so on the Lackawanna. On this road, not only all shops, but likewise their equipment and their personnel, are considered of fundamental importance; because, without ample, and above all, dependable, motive power and equipment, the efficiency of the transportation machine is badly handicapped. Every locomotive and car that is out of productive service is an investment of the railroad that, for the time being, has become an expense. Furthermore, by reason of constantly changing conditions and the improvements that are being made with astonishing frequency, locomotives become out of date with increasing rapidity. It is more important than ever before, therefore, to keep them as continuously in productive service as possible.

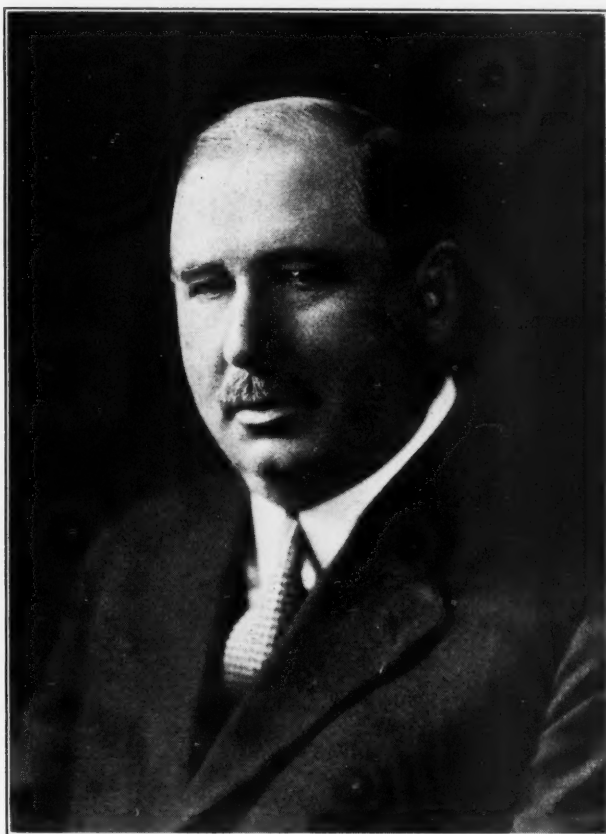
The demands of transportation service today call for the rapid, and particularly the punctual, movement of traffic. The locomotive of today is required, therefore, to be in service more continuously than at any time in the past, aside, perhaps, from world-war days. As a consequence, it is of growing importance that the periods when it is removed from service, or stopped for maintenance or for periodic inspection, be few and far between.

Keeping motive power and equipment in service is the function of the shop. In order to make the

most of the present-day situation, both the shop and its equipment must be brought abreast of the changed conditions in the railroad world. Likewise, the personnel must be carefully selected and trained.

On the Lackawanna, for instance, the lay-out of the shops and the movement of equipment units, repair parts, and materials through them was ac-

corded careful study, to the end that the progress of the work would be as direct and as rapid as it could be made to be. Next, the machine shop equipment—because new machinery and tools are being constantly designed to reduce repair costs—was thoroughly gone over, not from the standpoint of the possible term of service which any particular unit might still possess—as that is not so important—but entirely from the viewpoint of its economic operation, as compared with the latest, improved machine for performing the same type of work. If the old machine failed to measure up—out it went and in came the machine that had a producing power which justified its purchase. In other words, the entire reconditioning plant was equipped with the



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J. M. Davis, President,
Delaware, Lackawanna & Western Railroad Co.

latest design and the most efficient type of machine equipment, with the result that both repairs and repair parts are produced at the minimum of both time and cost.

One instance out of many will serve to illustrate the point. In our Scranton, Pa., shop we had an old journal-turning machine, in good working order, that was turning out driving-wheel journals at the rate of seven per eight-hour day, at a cost of \$1.10 each. Investigation disclosed the fact that there was on the market a later, improved machine which would do more and better work and not only pay for itself, but also earn a profit. It was promptly installed. The new machine requires the same labor to operate, and turns out thirteen journals in the same time, at a cost of 65 cents each.

Since all of our locomotive and car shops are operated on a piece-work basis, this policy of stepping up production through the installation of modern machinery has the effect of increasing the compensation of the employees.

The installation of electric welding equipment and oxy-acetylene cutting and welding equipment has greatly speeded up the time and materially reduced the cost of making repairs to both locomotives and equipment. The use of alloy steels has become an important factor in the construction of locomotive parts. These materials require not only special preparation, but scientific heat-treatment as well. This, in turn, brings about the necessity for the use of modern furnaces and laboratories in order to make certain that the materials contain the proper chemical composition and physical properties and have received the correct treatment to give them the required tensile strength.

Then, our personnel is carefully checked up. The right man does better work in the right place. Supervisory officers must be highly trained, have an expert knowledge of the use of modern facilities, and be ever ready to take advantage of suggestions calculated to conserve time in conducting repairs, meanwhile making time studies and other experiments with a view to facilitating the work and reducing costs. Employees, likewise, must be thoroughly trained in and familiar with their particular duties.

The outcome of this policy has been that our shops have become highly specialized. Production has been materially increased and repair costs have been greatly reduced. Stand-by losses have been cut down and engine-house expenses have been noticeably lessened. The repair work turned out is more dependable, and both locomotives and cars spend less time out of service and more time on the road.

* * *

FOUNDRY CONVENTION AND EXHIBITION

The American Foundrymen's Association held its annual convention and exposition of foundry equipment and supplies in Philadelphia during the week beginning May 14. The exhibition was held at the Commercial Museum, where many new and improved machines for the foundry, as well as much well-known equipment developed in recent years, were shown. This is the first exposition of the American Foundrymen's Association since that held in Detroit, September, 1926. Considerable progress has been made in foundry equipment since that time, as evidenced by the exposition. During the convention a great many papers were read covering almost every phase of foundry practice. Those interested in these papers are advised to communicate with C. E. Hoyt, secretary-treasurer, 140 S. Dearborn St., Chicago, Ill.

* * *

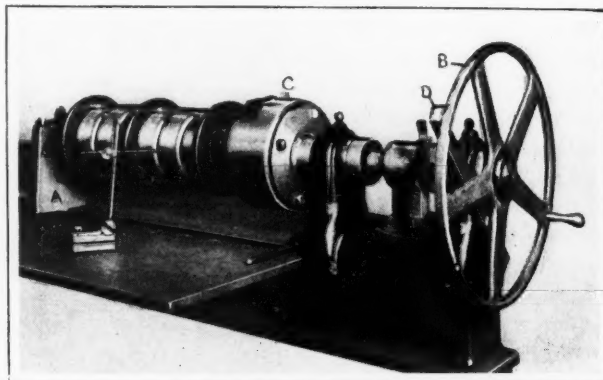
Since the fall of 1926, when the work of lighting the United States Government airways was started, a total of 4500 miles has been adequately lighted, and an additional distance of 2500 miles is now being provided with lights to guide air mail pilots. The total length of the present system of airways in the United States is 12,000 miles.

CONTROLLER-DRUM LAYING OUT MACHINE

An accurate machine of the construction here illustrated is used in laying out the lengths of contacts and centers for holes on controller drums in the Renewal Parts Plant of the Westinghouse Electric & Mfg. Co., which is located at Homewood Station, Pittsburgh, Pa. Machines of the same design could be built for other cylindrical work.

The machine is a reconstructed speed lathe, which has been provided with wide machined plates that serve as a table. These plates are separated at the middle of the machine so as to form a groove along which a tongue fastened to tailstock A slides when the tailstock is being positioned to suit the length of work. This tailstock consists essentially of an angle-plate which can be clamped to the table as required.

Mounted on the headstock spindle is a wheel B, 16 inches in diameter, the rim of which is graduated in 1/2 degrees. A clamping device facilitates



Machine Used in Laying Out Cylindrical Work

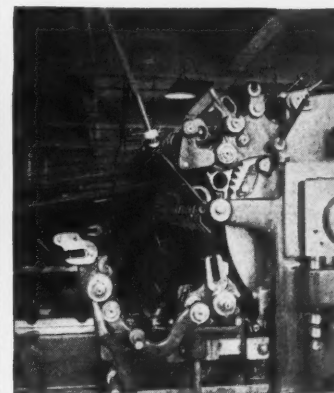
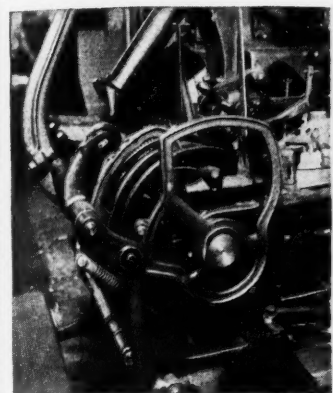
locking the headstock spindle in any position. A standard two-jawed chuck C supports the work at the headstock end of the machine.

In using this equipment, it is an easy matter to tighten the chuck jaws on work with the zero graduation of wheel B coinciding with an index line on bar D, and with the pointer of the height gage indicating a scribed line on the work. Then any number of angular locations can be conveniently obtained by merely indexing wheel B the required number of degrees, and clamping the spindle stationary to permit scribing a line with the height gage pointer.

* * *

Early attempts to apply steam to useful work, says *The Locomotive*, were handicapped not alone by the mechanical inadequacy of the crude boilers to withstand pressures greatly above atmosphere, but also by a skeptical and timid public which, one writer tells us, besought the British Parliament to pass a law limiting pressures to five or six pounds. While boiler accidents still occur, particularly when equipment is allowed to deteriorate for want of inspection, public confidence in the science of engineering has increased in the last hundred years to a point where pressures up to 1400 pounds in industrial installations cause no great alarm, and the traveling public raises no protest in the name of community safety at the announcement of a new locomotive which will operate at a pressure of 400 pounds.

Ingenious Mechanical Movements



TRANSMISSION GEAR LAPPING

By MERRITT R. WELLS

Much has been written on the subject of gear noises, their causes and suggested remedies. Statements and claims have been decidedly at variance with each other, although a broad view of the matter shows that the conditions under which gears work differ so that a successful remedy for one transmission may not be satisfactory for another.

In the case at hand, two designs of transmission gears were produced by the same plant for two different automobile concerns. The load and other conditions existing in one transmission were such that little noise was noted, even with gears whose teeth might be called only rough-cut. On the other hand, the second transmission had narrow gears and high tooth pressures, with the result that they were noisy, in spite of the greatest care in cutting.

That an error of as little as 0.00025 inch might cause noise, as some of the best authorities on gears have stated, was at first contradicted, and so in order to obtain the facts in the case, a Lees-Bradner profile tester was so altered that the profile and spacing for a given gear under observation could be determined time after time and readings obtained checking with variations seldom exceeding 0.00005 inch. Some 2500 readings made on various gears (some quiet, others noisy, and some tested after hardening, etc.), bore out the statement regarding the 0.00025 inch error and proved that the errors in profile and spacing introduced by distortion during heat-treatment were equal to or greater than the difference between errors of a satisfactory gear and a rejected one. This naturally brought up the question of grinding the gears, but to the writer this did not appear to be feasible, the results in production being questionable and the matter of cost putting it entirely out of bounds. An im-

proved method of lapping was therefore proposed, and has proved satisfactory after extended use.

Why Gears Wear Less at Pitch Line

Let us first consider what occurs when a lapping compound of any sort is fed through involute gears running on fixed centers. Referring to Fig. 1, which shows only the contacting faces of two involute teeth, it will be noted that the point of contact between the teeth is always on the straight line passing through *A* and *C* which indicates the pressure angle. During the instant that contact is at *A* it is evident that the point of contact on the pinion is moving perpendicular to the radius *AP* while that on the gear is moving perpendicular to the radius *AG*. They are therefore not moving in parallel paths, but approaching each other, and hence must slide with respect to each other. The same is true of point *C* on the two gears, except that there they are separating, if the pinion moves counter-clockwise.

With contact at *B*, however, on the pitch lines of both gears, the radii coincide; the paths are for the instant the same, and consequently there is then true rolling and no sliding between the two surfaces. This means less lapping or wear at the pitch lines and more wear as we go either side of the pitch line, provided contact continues that far. Badly worn gear teeth often appear somewhat as

shown in Fig. 2, where the pitch line is clearly indicated by a decided high ridge.

Advantages of Shifting Gears while Lapping

If we attempt to lap gears on fixed centers, we find evidence of this ridge at the pitch line where little or no lapping occurs. When, however, the gear centers are separated somewhat, we find that while the gear action is theoretically correct, the pressure angle has been changed and the pitch lines located in new positions farther from the

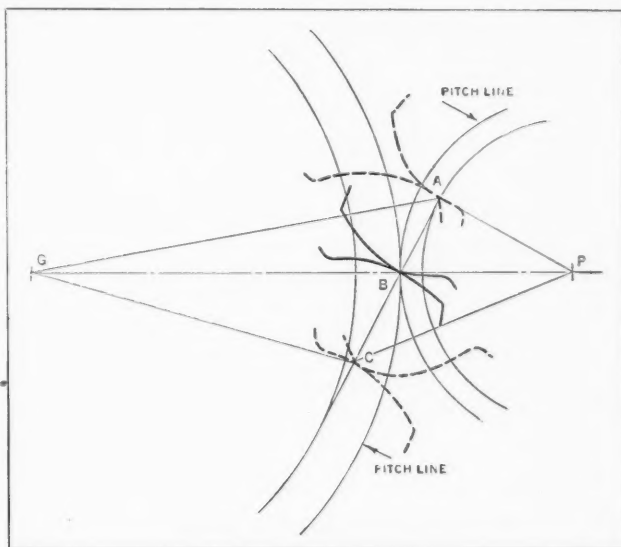


Fig. 1. Diagram to Illustrate Gear Tooth Action

centers. This means that the original pitch-line ridge has been shifted into the lapping zone and, being higher than the adjacent surfaces, it takes the brunt of the lapping action until eliminated.

Another difficulty sometimes noted during lapping is the tendency for the tip edge of the tooth surface, where engagement first occurs, to lap off slower than the adjacent surfaces, thus leaving a high ridge just where interference is most likely to be found. This possibly is caused by the sharp entering edge scraping the lapping compound ahead of it, instead of pulling it in between the teeth, as occurs after the point of contact has moved a little way down on the profile, and an entering wedge is thus provided. To overcome this difficulty, the gears may be "bottomed" during a suitable portion of the lapping time.

It is at once evident that with the gears on fixed bearings, portions near the ends of the teeth are likely not to be lapped, as a result of inaccuracy in either length or location. Shifting one gear back and forth endwise during the lapping process overcomes this trouble. The problem was to obtain all these movements with a fixture that would not be too slow or expensive for production purposes. This meant lapping a number of gears at once, preferably in sets. It was accomplished as described in the following.

Arrangement of Lapping Fixture

The transmission is of the standard three-speed and reverse sliding gear type, the cluster gear being cut from the solid and carried by plain bushings on a stationary shaft. Referring to Fig. 3 (in which for the sake of clearness, the general scheme rather than actual details are given), it may be seen that at one end of the bedplate *A* is the driving head provided with a combined pulley and flywheel *B*, having bearings on each side. At the outer end is a small-diameter grooved pulley *C* for driving the

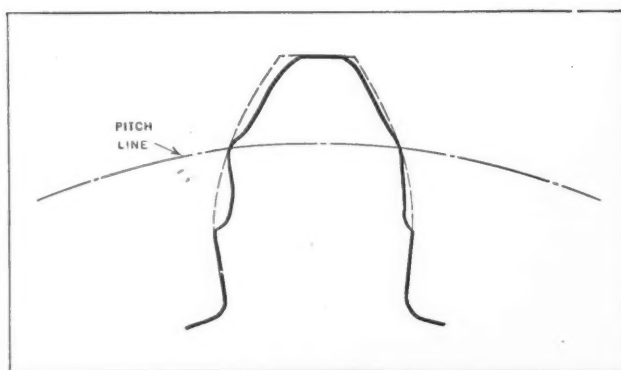


Fig. 2. Illustration of Badly Worn Tooth

disk or cam *D* referred to later.

Provision is made both for different sized bushings *E* and a broached adapter *F*, by means of which the forward end of the clutch shaft and stem gear *G* is centered and driven. A stationary housing carries an adapter *H* and ball bearing whose inner race is ground to a slip fit on the

rear bearing of stem gear *G* which it locates.

The two sliding gears *J* and *K* are carried on a special spline shaft *L*, which is in line with the shafts previously mentioned and is mounted on ball bearings in a tail-head *M*. This can be slid along suitable ways on the bedplate by means of a simple lever (not shown). At one end of shaft *L* is a small flywheel *N* which not only provides uniform speed, but also acts as a brake wheel. The brake shoe *O* is carried in a guide attached to the tail-head and is applied by means of a weighted lever. At the other projecting end of shaft *L* is the splined section upon which the low and reverse speed sliding gear *K* is carried. Beyond this, the diameter is reduced to receive a bushing *T*.

This bushing is splined on the outside to fit the high and intermediate speed sliding gear *J*, which is, therefore, forced to rotate with bushing *T* rather than with shaft *L*. Inside of this bushing slides a plunger *P*, which is pushed out by spring *Q*, its travel being limited by slot and pin *R*. Supported on the outside of bushing *T* is the fiber separator *S* between gears *J* and *K*. In the running position, spring *Q*, through plunger *P*, presses against stem gear *G*, holding it in place. At the same time, through bushing *T*, it holds sliding gears *J* and *K* in place and provides the necessary pressure to give the desired friction, referred to later, between these gears and the fiber separator *S*.

While loading or unloading, the tail-head *M*, together with the parts it carries, is slid toward the right to allow for the easy removal first of gears *J* and *K*, bushing *T*, plunger *P*, and separator *S*, and

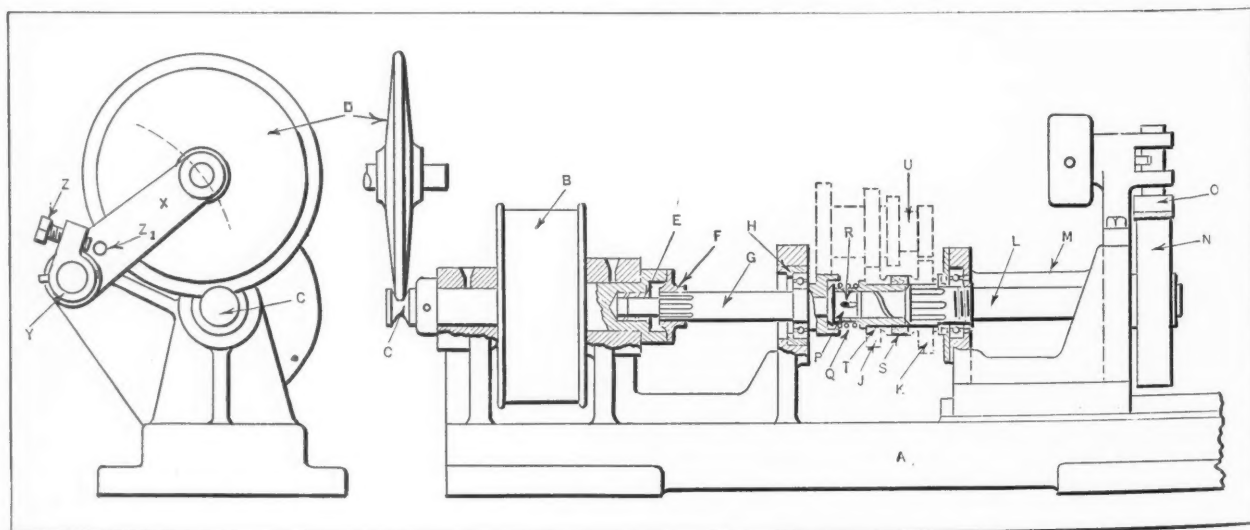


Fig. 3. Lapping Machine Designed to Vary the Center Distance, Move the Gears Endwise, and Provide a Dwell with the Gears Bottomed During the Lapping Operation

later the stem gear *G*. In lapping, the stem gear *G* drives the constant-mesh gear of cluster gear *U*, while at the same time, gears *J* and *K* are both in position for second and reverse speeds, respectively. Gear *K* does not mesh directly with the cluster gear, but is connected with it through the reverse idler gear *V* (Fig. 4), which is carried on a stub shaft projecting from a bracket attached to the tail-head.

The diagram Fig. 4 shows an end view of the right-hand end of the fixture. As this view shows, cluster gear *U*, instead of being located directly above, as indicated by the dotted outline in Fig. 3, is actually somewhat to the rear. Its shaft, instead of having a fixed position, is carried by two arms *W*, rigidly attached to a lay shaft *Y*, which extends the full length of the bedplate. By means of this shaft, the cluster gear can be swung over the arc indicated, thus altering, with one exception, the center distances of all gears in mesh. The exception is between the reverse idler *V* and reverse sliding gear *K*, Fig. 3. However, the center distance between the same idler and the cluster gear with which it is in constant mesh does change, and hence its pitch line ridge is cared for.

The direction of rotation, as well as the loaded faces of all gears, is the same as in the car. The load under which gear *J* and its mate are lapped depends upon the friction against the fiber separator *S* (which is between two gears running in opposite directions) and the friction between stem gear *G* and plunger *P*, which also run in opposite directions. The load on the other gears is determined not only by the friction loads just mentioned, but also by the brake load applied to flywheel *N*. We thus lap the normal working faces of all gears except for first speed, which is seldom used and therefore unimportant.

How Lapping Motions are Derived

Let us next see how the various movements of the cluster gear are obtained—first, a changing center distance, second, a dwell for a time with the gears bottomed, and third, an endwise motion. Evidently this cycle cannot occur once per revolution of any of the gears; hence the necessity for some speed-reducing means. Various schemes were considered until the writer conceived a simple wobble cam to take care of all three motions.

Referring to the end view in Fig. 3, it may be seen that cam *D* rests in the groove of small pulley *C*, and owing to the wide difference in diameters is rotated slowly thereby. Cam *D* is eccentric and hence imparts a rocking motion to the fork *X* in whose arms are the bearings for the shaft upon which cam *D* is rigidly attached. Now fork *X* is pivoted on shaft *Y* to which the cluster gear arms are rigidly attached. Fork *X*, however, is not rig-

idly attached, but is free on shaft *Y*, except that it is retained endwise by collars. On one of the latter is the adjustable stop-screw *Z* which strikes the pin *Z*₁ on fork *X*.

This fork, through the screw *Z* and the shaft *Y*, can raise the cluster gear out of mesh, but cannot reverse the motion; hence a weighted lever (not shown) is attached to shaft *Y* to swing the cluster gear into mesh and cause the gears to bottom only with a predetermined force. The adjustment of screw *Z* governs the relative time during which the gears bottom or lap with their centers varying.

Shaft *Y* and all parts attached to it are free to move endwise, except for the restraining action of eccentric cam *D* resting in the groove of pulley *C*. As the plane of cam *D* is not perpendicular to its axis, it wobbles, and since its rim is in a fixed groove, the shaft *Y* and cluster gear are forced back and forth endwise.

The relation between the wobble and eccentricity of cam *D* is such as to produce the fastest endwise motion while the center distances of the gears are greatest, as well as while the gears are bottomed. The resultant motion is elliptical, except for a flat side at the bottom during the time the gears are bottomed, thus assuring the full length of the teeth being lapped under this condition.

The lapping compound, which is of creamlike consistency, is carried in the reservoir or box *B*₁

(Fig. 4), attached to shaft *Y*, and provided with cocks and drip tubes over the various gears. While loading or unloading the machine with gears, the cluster gear is swung up out of the way, the same movement tipping the box *B*₁ to a position where it will not feed.

It is interesting to note that the vibration of the machine helps to feed the compound, and so when the machine is stopped, the compound also stops feeding even before the box is tipped back. The compound thrown from the gears while running is caught by aprons (not shown) and drained into a can, from which it may easily be returned to the feed box. Provision is made for lapping different sized gear sets by the use of detachable brackets, adapters, etc.

This machine and process have, after many months in production service, proved very satisfactory. Not only has a general improvement in gear noise been noted and many dollars saved by eliminating the excessive number of transmissions to be torn down and rebuilt, but hundreds of sets of gears that had been previously marked for scrap on account of faults in cutting (such as flats) have been salvaged. When one man can load, lap, unload, and wash gears at the rate of one set in five minutes, evidently the cost is not excessive, and is certainly many times cheaper than gear grinding.

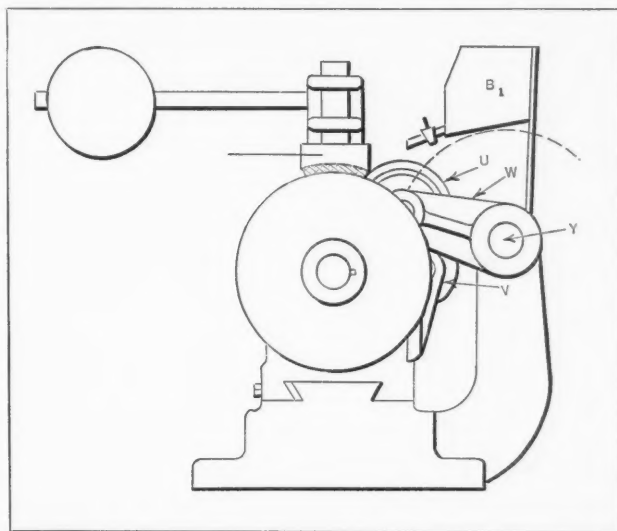


Fig. 4. Right-hand End View of Machine Shown in Fig. 3

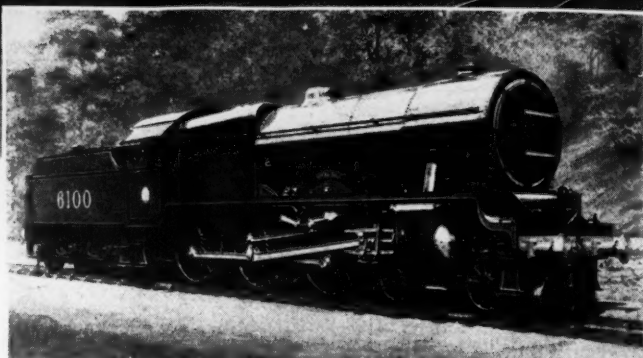
British Railway Shop Practice



Latest Methods Developed in England for Machining Locomotive Cylinders

THE problem of developing improved methods for machining locomotive cylinders has for some time engaged the attention of British railway shop engineers. It is generally recognized that locomotive cylinders are difficult to handle, even under the most favorable conditions, owing to their weight, bulk, and amount of machine work required. The work generally involves a large number of different settings which, as a rule, consume more time than the actual machining operations, and permit troublesome cumulative errors to creep in, which can be avoided only by maintaining a high degree of accuracy on each individual operation.

Increased production and greater accuracy could,



Engine 6100 of the London, Midland & Scottish Railway which on April 27, Pulled the "Royal Scot" on its First Non-stop Run of 400 Miles between London and Edinburgh

of course, be obtained by developing special machines and tool equipment, but it must be remembered that locomotive cylinders are not usually required in sufficient quantities to warrant that expense. Realizing this, H. W. Kearns & Co., Ltd., Broadheath, England, undertook a series of tests with the object of ascertaining to what extent production could be improved by the efficient use of standard machines and equipment, without sacrificing accuracy and quality of finish. The methods

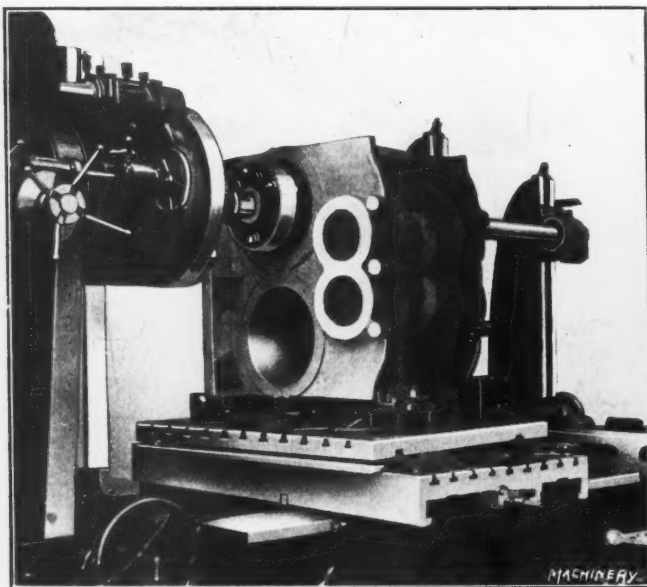


Fig. 1. Boring Operation on Cylinder Shown in Fig. 8

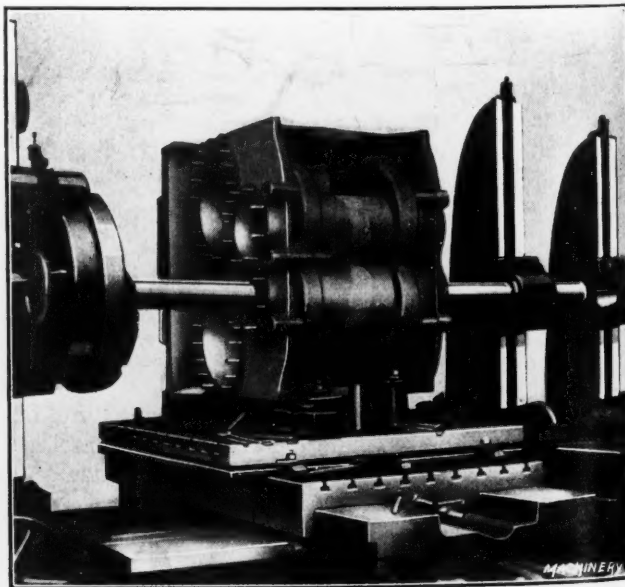


Fig. 2. Boring Valve Lines of Cylinder Shown in Fig. 1

developed and the production rates obtained as a result of these tests, which extended over a period of twelve months, are recorded in this article.

The machine used in making the tests was one of the company's own make, a high-speed surfacing, boring, milling, drilling, and tapping machine, with a spindle 5 inches in diameter. During the tests, a number of locomotive cylinders of representative types, supplied by various British and Continental railways, were machined under the direct observation of representatives of the railway companies. The production rates obtained under these conditions, without employing any special jigs, fixtures, or

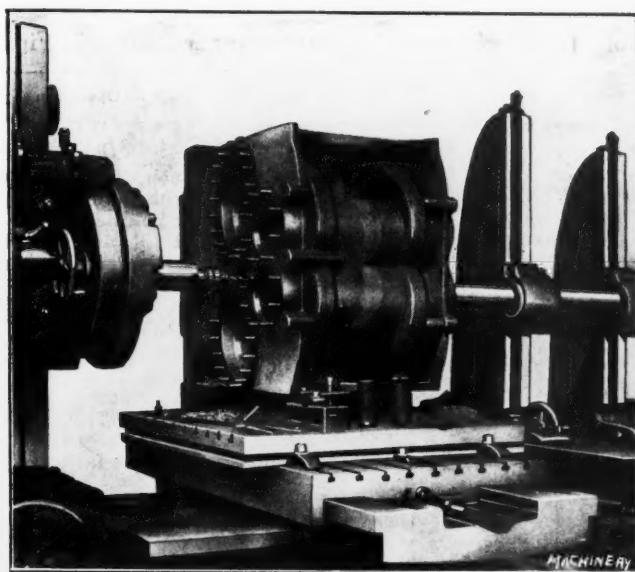


Fig. 3. Drilling, Tapping, and Stud-setting Operation on Cylinder Shown in Fig. 8

locomotive cylinder work. The machine is of the universal type, having a variety of easily controlled slide movements. This permits the position of the work to be changed repeatedly and operations of different kinds to be performed without actually resetting the work.

In most of the tests, the cylinders required only three settings, and in one case, only two settings were necessary. The machine is of standard design, equipped with an extra outer support which permits the boring-bar to be completely withdrawn from the cylinder without removing it from the machine while the position of the work is being changed.

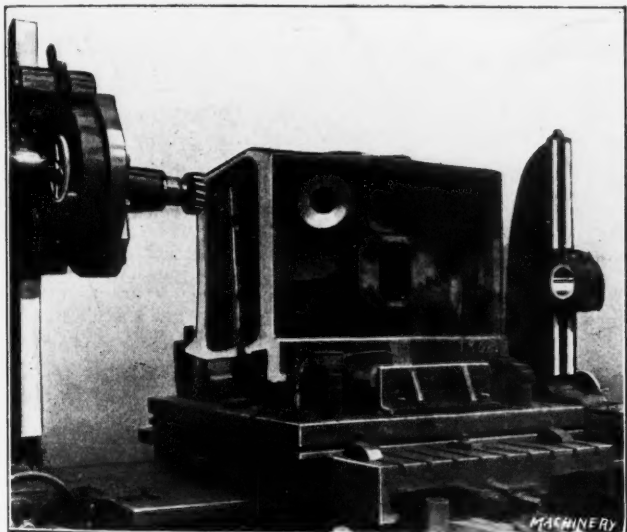


Fig. 4. Milling Side Frame Faces of Cylinder

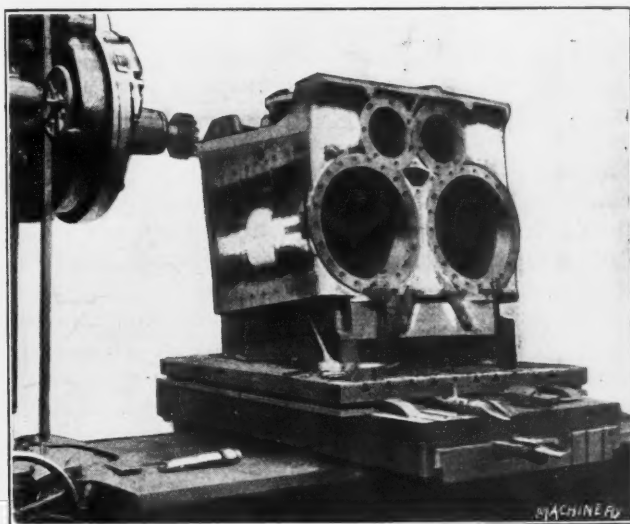


Fig. 5. Milling Taper Side Faces of Cylinder Shown in Fig. 6

other equipment, are considered exceptionally good in British practice. American railway shop executives will be interested in comparing these production figures with practice in this country.

The machine employed, which is shown in the accompanying illustrations, has a wide capacity range and a multiplicity of feeding movements. It is adapted for machining work ordinarily handled on planing or milling machines and for drilling, tapping and inserting studs in tapped holes. The boring and facing features are similar to those of a duplex-spindle boring machine, such as is frequently used for

Operations on Twin Cylinder

Although the difference in the design of the various cylinders necessitated some variation in the machining methods, the general procedure was the same in all cases, and is illustrated in Figs. 1 to 4 inclusive. These illustrations show typical stages in the machining of the 19-inch diameter by 26-inch stroke twin cylinder for a London and North Eastern Railway locomotive of the W class. Details of this cylinder are shown in Fig. 8. It will be noted that the cylinder differs from the usual type in having the valves located at an angle with the cylinder bore.

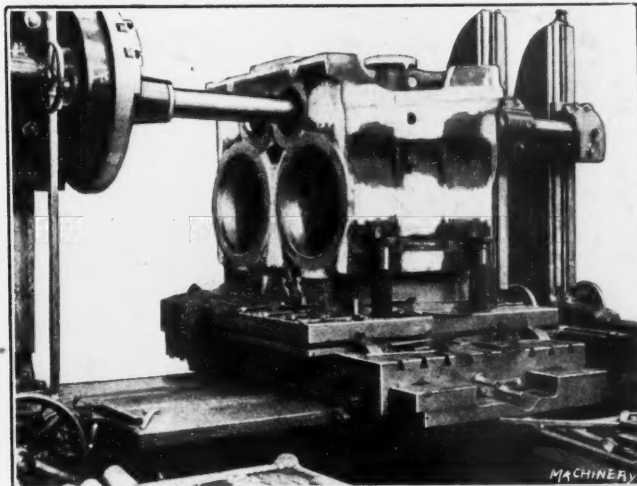


Fig. 6. Boring Valve Lines in 20-inch Diameter by 26-inch Stroke Inside-admission Cylinders

Table 1. Machining Time for Cylinder Shown in Fig. 8

Operation	Hrs.	Mins.	Operation	Hrs.	Mins.
First setting	2	00	<i>Drilling</i>		
Bore right-hand cylinder.....	3	50	38 holes 1 inch diameter, tap and stud....	5	05
Bore 8 1/4-inch diameter.....	0	40	14 holes 1 inch diameter, tap and stud....	1	25
Bellmouth	1	40	3 drain cock holes and face.....	1	30
Bore left-hand cylinder.....	4	50	14 holes and 2 drain cock holes.....	1	10
Bore 8 1/4-inch diameter.....	0	25	Drill and tap back valve faces.....	1	15
Bellmouth	1	10	2 drain cock holes.....	1	00
Face R.H. and L.H. cylinders. Front.....	2	45	Total	54	15
Correct bellmouth for depth (unnecessary operation)	1	20	Second Setting	1	10
Face front of valve lines.....	1	15	Mill right-hand frame.....	2	30
Bore right-hand valve.....	4	30	Mill left-hand frame.....	3	30
Bore left-hand valve.....	3	40	Mill slot	0	50
Mill front saddle plate.....	1	55	Face and recess three flanges.....	1	50
Face left-hand cylinder. Back.....	2	00	Drilling and back-facing.....	2	20
Machine clearance at bottom of left-hand cylinder	3	05	Total	12	10
Face right-hand cylinder. Back.....	1	10	<i>Summary</i>		
Machine clearance at bottom of right-hand cylinder	2	00	Settings	3	10
Mill two pads.....	0	20	Boring cylinders	13	55
Face R.H. and L.H. valve flanges. Back...	1	05	Facing cylinders	11	00
Clearance in valve ports L.H. and R.H. Front	0	25	Boring valves	8	10
Clearance in valve ports L.H. and R.H. Back	0	45	Facing valves	3	30
Mill tube plate faces.....	1	40	Milling and facing	12	55
Mill edge of front saddle plate (for ease in 2nd setting)	0	20	Drilling, tapping, and studding.....	13	45
			Total time	66	25
			<i>Machinery</i>		

At the first setting, shown in Fig. 1, the casting is placed on one of its side faces on an auxiliary work-table. This table is part of the standard equipment, and revolves on a pivot on the top of the regular compound table. With this arrangement, it is possible to revolve the work about a vertical axis and also adjust it transversely and longitudinally in relation to the boring head. The boring head can be adjusted in a vertical direction, and is provided with a boring spindle and a facing slide. The casting is located by means of squares and scribing blocks, indications provided at a previous marking off operation being used for lining-up purposes. Ordinary packing blocks and bolts are used to hold the work in place.

The time required for setting the casting in this case was 2 hours, and except for slight adjust-

ments, it remained undisturbed for a period of 52 hours 15 minutes while the work recorded in Table 1 was being performed. In addition to completely boring and facing the cylinder and valve lines, the front saddle plate was milled, as were also various other flat surfaces ordinarily finished by planing. All the holes in a horizontal plane in each of the four vertical faces were drilled, tapped, and studs inserted where required. The positioning of the work to give the required angle between the bores of the valves and the cylinders was accomplished by turning the auxiliary work-table on its pivot pin. The two positions are shown in Figs. 1 and 2. Fig. 3 shows the method of using the machine for drilling, tapping, and setting the studs.

Accuracy in spacing the holes in the circular flanges was insured by adopting the method of

Table 2. Machining Time for 20-inch Diameter by 26-inch Stroke Inside-admission London, Midland & Scottish Railway Co. Locomotive Cylinders

Operation	Guaranteed Machining Time, Hours Minutes		Actual Machining Time, Hours Minutes		Remarks
First setting	2	00	0	30	1 hour lost. Broken shear pin.
Machining top and bottom of cylinder.....	5	00	7	40	
Smokebox facing	nil		1	40	
Drill top and bottom of cylinder.....	7	00	8	00	
	(50 holes)		(86 holes)		
Second setting	1	30	1	25	Includes all setting of tools.
First cylinder bore, including chamfer.....	6	25	8	00	
Second cylinder bore, including chamfer....	6	55	7	40	
First valve line.....	4	15	3	25	
Second valve line.....	3	45	2	30	
Facing cylinders and valve lines, including inside facing	6	05	10	00	Includes three hours' wait for new set of tools. Original ones unsuitable.
Milling sides, excluding taper face.....	3	50	3	50	
Drilling and tapping front and back.....	13	50	8	25	
	(103 holes)		(106 holes)		
Drilling and tapping back-facing sides, excluding the ones in the angle.....	2	15	3	35	Back-facing not included in original estimate.
	(42 holes)		(36 holes)		
Third setting	1	30	1	45	
Milling taper side and tube plate facing....	6	45	6	00	
Drill and back-face holes on taper.....	5	15	3	30	
	(44 holes)		(38 holes)		
Total	76 hours 20 minutes		77 hours 55 minutes		<i>Machinery</i>

slide adjustment illustrated in the diagram Fig. 7. This diagram indicates the movements employed in drilling an eight-stud flange in which the holes 1 to 4 are drilled in consecutive order. After locating the work and boring the first hole, the head is adjusted vertically for drilling the second hole. The intermediate work-table is then adjusted transversely into position for drilling the third hole. The simple

vertical adjustment then brings the work into position for drilling the fourth hole. In all cases, the distance through which the slides are adjusted is measured by micrometer dials on the machine.

The holes 5 to 8, inclusive, constitute a second group which are dealt with the same as the first group, although a slightly different range of adjustment is necessary. It is evident that this method can be employed for drilling any equal number of accurately spaced holes without the use of drill jigs.

At the second setting, shown in Fig. 4, the casting is located on the revolving table with the cylinder bores in a vertical plane. The casting rests on machined packing blocks, and is squared by means of the angle-plate shown in contact with the edge of the front saddle plate, which was machined for this purpose at the previous setting.

The time required for setting up the work in this case was 1 hour 10 minutes. The machining operations for the second setting, as recorded in Table 1, were completed in 11 hours. These operations consist mainly in milling the frame and flanges. For this work, the vertical traverse motion of the boring head and the transverse traverse motion of the intermediate work-table were utilized. Inserted-tooth milling cutters, mounted on the spindle nose,

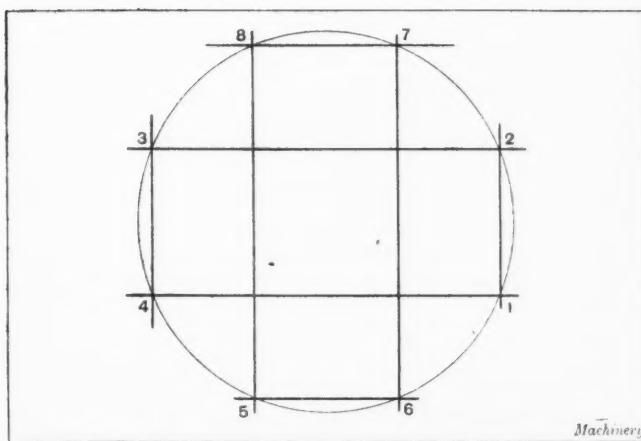


Fig. 7. Diagram Showing Method of Adjusting Slides in Drilling Flange Holes

three settings were necessary, during which time the operations recorded in Table 2 were performed. The machining time on this cylinder exceeded by 1 hour 35 minutes the estimated time of 76 hours 20 minutes, owing to interruptions in the work, as noted in the right-hand column of the table.

For the first setting, the cylinder was located exactly the same as for the operations shown in Figs. 1 to 3. At the first setting, four flanges, one at each corner of the bottom face, were machined. The casting rested on these machined flanges during the second operation, which is illustrated in Fig. 6. This operation consisted of boring the valve lines, employing a simple jig plate for locating the work.

A third setting was required for this cylinder, because of the stepped face on each side, which is at an angle with the main face. For machining these faces, two taper wedge blocks were placed under the casting to tilt it to the required angle. The main side faces were machined at the first setting by traversing the intermediate work-table in a transverse direction and the boring head in a vertical direction. For machining the tapered faces at the top edge of the casting, the boring head was merely set to the required height and the intermediate work-table traversed in a transverse direction.

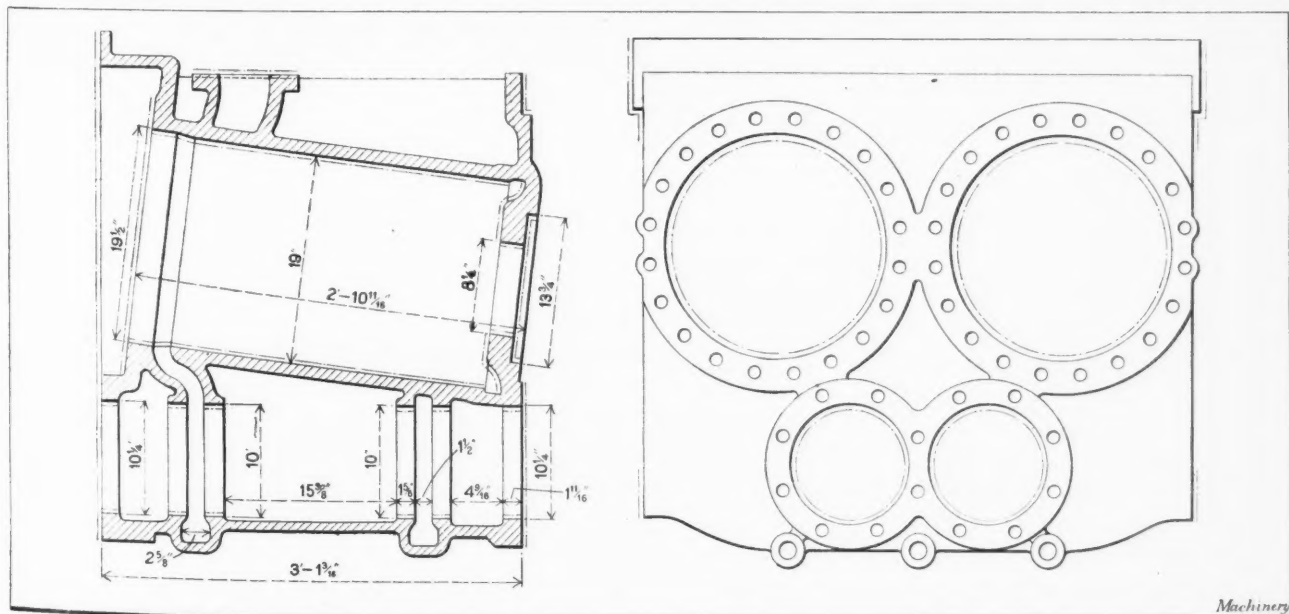


Fig. 8. Details of 19-inch Diameter by 26-inch Stroke Class W Twin Cylinder of London and North Eastern Railway Locomotive

What Are Patents and What is Patentable?

By H. L. KAUFFMAN, Consulting Engineer, Denver, Colo.

FEW engineers and designers have a clear understanding of what actually constitutes an invention or of the steps that the Government takes in endeavoring to protect a new and novel idea upon which the inventor is requesting a patent. Hence, this article should prove of real interest to most readers, since nearly all of us at some time or another feel that the idea we have in our minds is useful, has never before been tried and, consequently, is patentable. Unfortunately, upon investigation we usually find that, in one respect or another, we are wrong; and then immediately we begin to "think up" some other idea. Many difficulties on the part of inventors will be solved, it is believed, by a definition and discussion of the terms employed in patent procedure, as given in the present article.

What Rights Does a Patent Grant to the Inventor?

First, let it be said that a patent for an invention is a grant by the Government to the inventor of the exclusive right, for a period of seventeen years, to make, use, or sell the invention defined by the patent, this right being transferable by an instrument in writing. Contrary to popular belief, a patent does not insure to the owner of the patent the right to make, use, or sell the invention; but, instead, merely the right to exclude others from the benefits of the invention. Whether or not the patentee can make, use, or sell his invention depends upon whether in so doing he will infringe other outstanding patents, the owners of which have the right to exclude him from making, using, or selling the invention covered by their patents.

For example, an owner of a broad patent may not be able to use an improvement that is vital to the practical success of his invention; while the patentee of the improvement, in turn, may also find himself unable to operate under his patent, because it will infringe the broad patent. This, then, forms the logical basis for a business arrangement whereby both patentees may profit by cooperating and pooling their patents. Several examples of such agreements could be cited that have proved advantageous to both the inventors and to industry.

H. L. KAUFFMAN was born in 1897 at Royalton, Dauphin Co., Pa. He received the Bachelor of Science degree in chemistry at the Pennsylvania State College in 1919. Mr. Kauffman has been employed by the Texas Co. as research chemist and development engineer; by the Pierce Oil Corporation as assistant chief chemist; and by the Producers & Refiners Corporation as special process investigator, research chemist, process development engineer, chief chemist, and lubricating oil superintendent. Since March 1, 1926, he has been in business for himself with offices at 610 Midland Savings Building, Denver, Colo., specializing in patent litigation, research, and investigational work. Mr. Kauffman has obtained a number of patents on processes and methods developed by him, and is the author of seventy-five technical and semi-technical articles that have appeared in different trade journals. Two books on petroleum refining and lubricating oils and greases, by Mr. Kauffman, will be published shortly.

A patent possesses the elements of a contract since, in consideration of complete disclosure of a new and useful invention, the Government gives the inventor the right to exclude others from the enjoyment of his invention. The inventor, in applying for a patent, must give the Government such a full, clear, and exact description of the invention as will enable those skilled in the art to which the invention relates (or to which it is most nearly related) to make and use it after the expiration of the patent. Since the grant of the patent depends upon the disclosure, and the character and scope of the protection will depend on the manner in which the disclosure is drawn and on the claims made, the disclosure constitutes the heart of the patent and requires great care in preparation.

Contrary to the true idea of a monopoly, which is generally considered as being the complete control on the part of one company or individual of something that existed before and belonged to others, a patent creates a monopoly on something that did not exist before and that belongs to the patentee. Since this is not an objectionable monopoly, in legal discussions the patent law, therefore, provides that the rights of patentees (in so far as the subject of monopoly is concerned) are to be liberally construed, and any doubts are to be resolved in favor of the patentee.



H. L. Kauffman

Territory Covered by Patent Rights

The right conferred by a patent extends to all the territory mentioned in the grant and in the statutes authorizing the grant. In the United States, it extends throughout all the states and, while the rights extend to American vessels on the high seas, they do not extend to foreign vessels in our ports. In many countries, it is required that an invention be worked; if it is not, the patent becomes void. In the United States, however, if the inventor himself does not make use of his invention or if he refuses to license others under reasonable terms to use it, he does not—as is true in many foreign countries— forfeit his patent or his right to exclude others from using his invention; the patentee alone has the right to decide whether or not he shall use his invention or shall license it to others.

Not even the United States Government has the right to use a patented invention without compensation to the patentee, although the owner's consent is not positively necessary for the Government to use an invention described in a letters patent, particularly when that invention relates to the construction of implements of warfare needed by the Government. However, no injunction can be ob-

tained against the Government or against an official acting for the Government, unless expressly permitted by act of Congress, nor can suit for damages be brought against the Government for infringement. The only method by which the owner of a patented device can obtain compensation for Government use of an invention is by bringing suit on the grounds that there was an expressed or implied contract.

In the United States, a patent cannot be cancelled by any officer of the Government, but can be cancelled by a judicial decision of the Courts upon proper action instituted by the Government for that purpose. A patent right is personal property and, in so far as its nature permits, it is subject to the general laws relating to property of that classification. Consequently, patent rights are surrounded by the same rights and the same sanctions that attend all other kinds of personal property.

Constitutional Authority for Granting Patents

The Congress of the United States has power to grant patents under the constitutional provision that it shall have power "to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." The power of Congress to grant a patent to inventors is general. It is in Congress' hands to say when, for what length of time and under what circumstances the patent for an invention shall be granted. Under the Constitution, the power may be exercised in making special grants to inventors and, further, Congress may grant a patent for something that is in public use. However, Congress cannot take away the right of a party to use an article previously purchased by him.

Contrary to the patent laws of England, where one who imports knowledge of an invention from abroad is entitled to a patent, the Congress of the United States has no authority to grant patents to anyone except to inventors and discoverers and, hence, cannot grant a patent to someone who merely imports a device not before known and used in this country. The patentee must be the inventor.

What is Patentable?

The question as to what subject matter is patentable is of interest to all inventors. In general, it can be said that, in the United States, patentable subject matter consists of any new and useful art, machine, article of manufacture, or composition of matter; or any new and useful improvement thereof; or any new, original and ornamental design for any article of manufacture.

Only physical things or acts producing physical effects are patentable. One cannot patent mental theories or plans of action; neither is an idea patentable, although the means of utilizing it practical-

ly can be patented. In all cases, the mental conception must be susceptible of embodiment, and must have been, in fact, embodied in some mechanical device or some process of art. Some subject matter that is not patentable is listed in the following:

(1) The discovery of a new principle or law of nature cannot be patented; (2) a particular end or result to be accomplished is not patentable; (3) a principle in the abstract, a fundamental truth, an original cause, a motive—none can be patented, because no person can claim in any of them an exclusive right.

The patentee is always restricted to the particular device by which he has undertaken to avail himself of the beneficial influence of the principle. Consequently, in regard to laws of nature, the processes used to extract, modify, and concentrate them constitute the invention. Invention lies, not

in discovering the elements of power, but in applying that power to useful objects. A patent is granted for the discovery or invention of some practicable method or means of producing a beneficial result, and not for the result itself. The means devised for utilizing the principle or accomplishing the end or result may be patentable, whether it is by chemical agency or combination, or by utilizing principles of natural philosophy or mechanics.

"Art" is Patentable Subject Matter

The term "art" has been defined by the United States Supreme Court as being "an act, or a series of acts, performed upon the subject matter to be transformed and reduced to a different state or thing . . . The process

requires that certain things should be done with certain substances and in a certain order." An art or process is patentable, just as machinery can be patented. But in patent law, where the term has a more restricted meaning, "art" has reference to the steps followed or successive acts performed in producing some desired physical effect.

To be patentable, the art or process must either produce some article or substance or change the physical condition of some article or substance. However, it is not necessary that the thing produced shall be new, since a new process for accomplishing an old result is patentable. If a patent is to be granted for an art or process, that art or process must be a method of effecting a physical result and not a mere plan or theory of conduct. However, the physical result attained need not be a permanent condition of the article or substance acted upon, as, for instance, in the transmission of speech by certain regulated undulations of the electric current in the telephone. Attention is also called to the fact that the mere function of a machine is not a patentable process, although a patentable process may be performed by machinery.

A process may be patentable, irrespective of the particular form of the instrumentalities used, and such a patentable process is separate from and independent of any machine or apparatus used in performing it. As a rule, processes of manufacture involving chemical or other similar elemental action are patentable, although mechanism may be necessary to the application or carrying out of such a process, while those processes that consist solely in the operation of a machine cannot be patented. In a judicial decision on this point, it was stated:

"Most processes which have been held to be patentable require the aid of mechanism in their practical application, but where such mechanism is subsidiary to the chemical action, the fact that the patentee may be entitled to a patent upon his mechanism does not impair his right to a patent for the process, since he would lose the benefit of his real discovery (which might be applied in a dozen different ways) if he were not entitled to such patent."

When chemical or elemental action is called into play, the generally accepted understanding in patent law is that an art or process is under consideration, and such processes have always been regarded as being patentable. However, mechanical processes involving simple manipulation may be patentable, even where there is no chemical or elemental action, and the mere fact that the use of machinery may be necessary for carrying out the process does not render that process unpatentable. An art may be patentable even though the inventor himself does not have any knowledge concerning the principles involved in the practice of the art; but he must know and describe the steps by which the result is accomplished in order that those skilled in the art may practice the invention.

As previously mentioned, other subject matter that can be patented includes machines, articles of manufacture, composition of matter, improvements, and designs. A machine is a combination of mechanical elements (including movable parts), adapted to perform a mechanical function. A machine differs from an article or implement in that it has a rule of action of its own. It differs from a process in that a new process is usually the result of discovery; a machine, of invention.

An article of manufacture is any article or implement produced by human agency and adapted to perform a mechanical function, but having no rule of action of its own. A "composition of matter" is a mechanical mixture or chemical combination of two or more substances, and may be patentable. The test of patentability is the same as in machines.

An "improvement" is an addition to or change in a known art, machine, article of manufacture, or composition of matter whereby a useful result is produced, this "improvement" being patentable if it amounts to invention. The improvement may be upon the patentee's own invention. In patent

law considerations, the improved article does not need to be superior to the original in all respects—it being sufficient if the invention (in which the improvement is included) is useful and possesses some advantage (such as in the ease or cheapness of manufacture or in the functions performed by it) over the original for certain purposes.

A patentable design may consist of a new and ornamental shape given to an article of manufacture or an ornamentation to be placed upon an article of old shape. The "design" law deals with the appearance rather than the structure, uses, or functions of the article. To be patentable, the design must be novel and must have called for an exercise of the inventive faculties of the person, as distinguished from ordinary skill. The patentability of a design does not depend on its aesthetic value, but is determined by its appeal to the eyes of an ordinary man and not the eyes of a jury of artists. The same rules as to construction and validity apply

as in the case of mechanical inventions. (Other articles giving helpful patent information to inventors will be published in July and August MACHINERY).

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PUNCH PRESS ACCIDENTS

In the May issue of *Punch Press News*, published by F. J. Littell Machine Co., Chicago, Ill., statistics originally compiled by the National Safety Council are quoted, which indicate the great number of accidents resulting from the use of punch presses that are either inadequately guarded or that are not provided with automatic feed mechanisms. In the state of New York alone, there were, in one year, punch press accidents resulting in a total of 41,147 weeks of disability. Because of these acci-

dents, \$626,666 was paid in workmen's compensation. It is inadequate to measure the results of these accidents in dollars and cents or in time alone, because the suffering caused by accidents—for example, the permanent loss of a finger or hand—cannot be measured in money. Wherever possible, greater attention should be paid to the means whereby such accidents can be avoided. Most of them can be prevented by the use of either adequate guards or automatic feeds.

* * *

The Screw Machine Products Association held its regular meeting at the Great Northern Hotel, Chicago, Ill., on May 17. Dr. Arthur E. Swanson, who is retained by several large corporations as consulting economic engineer, addressed the meeting on the subject "Some Dangers in the Present Business Situation." Local groups of the Screw Machine Products Association now meet regularly in Cleveland and Chicago, and the Southwestern Ohio group holds alternate meetings in Cincinnati and Dayton. Malcolm Baird, 232 Delaware Ave., Buffalo, N. Y., is secretary.

What Constitutes Invention?

In July MACHINERY, in an article entitled "What Constitutes Invention?", H. L. Kauffman will discuss the basic principles that determine whether or not an invention has been made. Briefly stated, an invention has been made if, in view of (1) previous knowledge as recorded in printed publications, (2) patents, or (3) prior public use, the inventor has shown more than ordinary skill in making his invention. The great difficulty encountered is to define what is meant by "ordinary skill." The author explains the methods that guide the decisions of the "Patent Office in matters of this kind, and also points out how too early a disclosure of the elements of an invention through prior publication may prevent the granting of a patent.

Locomotive and Car Shop Equipment

By Sir HENRY THORNTON, President and Chairman, Canadian National Railways

THE present age is often spoken of as "The Age of Speed." Its influence is being felt by every transportation company, and it is prompting the marine engineer and the locomotive mechanical engineer to higher efficiency and greater speed. The machine tool builder is making a strenuous effort to keep apace with industry, and perhaps no greater example of this is found anywhere than in the automobile industry, where the machine tool plays an important part in production. Getting the most out of machine tools is being given careful thought by manufacturers. In the manufacturing industries, machine tools are vital, because without them there would be no product to sell.

In railroad work, the problem is more difficult, as a railroad shop is principally organized to recondition and maintain rolling stock—its product is not for sale. Often large manufacturers are not so keen on buying the latest machine tools for their maintenance department as they are for the production shop, which creates dividends. Considering the railroad shop problem, it must be realized that every locomotive coming in for repairs is a proposition in itself, so that it is practically impossible

in many cases to run work through the shop in fair sized lots; the majority of the work is done one or two pieces at a time. Locomotive shop tools have to be selected to handle a variety of work with fair efficiency, rather than to handle special work in good-sized lots at a higher rate of production.

Our company's policy is to make an appropriation for machine tools so as to secure the best results in handling the general class of work of the railroad shop. There are, however, cases where specially designed machines are employed which give good return on the investment. The older railroad men can well remember the time when locomotive shops were equipped with six or seven wheel lathes, which are now replaced by one modern tool.

There are two principal reasons for buying new machine tool equipment; the first and most urgent

is that when a tool becomes old and inefficient to the extent that it is undependable, causing delays by breaking down, and is too light to handle work of the modern locomotive, it should be replaced; the second reason is that with modern machinery the cost of repairs can be reduced. Also, in addition to saving labor on the machining of work, which might warrant the purchase of new machine tools, it frequently happens that enough idle time

of the locomotive can be saved to make the purchase of new machinery a good investment. This phase of locomotive maintenance is one that is worthy of attention.

The introduction of high-speed steel is another good reason for the purchase of more modern tools. Often it is found that the old machine will not stand up to the capacity of the steel. Therefore, there is a loss in production.

Another reason why the machine tool equipment should be carefully checked is the rapid advance, of recent years, in grinding operations. It is not merely a question of getting work out quickly, but of producing work that will give the best results. Hardened parts ground to an accurate finish will wear longer and reduce maintenance costs. The machine tool

designer is to be complimented on the recent advance made as a result of research and study, and the improved work in locomotive and car shops has not only greatly increased the efficiency of locomotives and cars, but has also gone a long way toward reducing the cost of railroad equipment maintenance.

How New Machine Tools are Selected

On our railroad, long before we reach the point where we are ready to order new machine tools for the shop, we are convinced as to the type of machine best suited for the work. It has been found that a good policy to follow is to have the foreman in whose department the machine is to be operated, visit a plant where a similar tool is in operation, so that he not only familiarizes himself with the



Sir Henry Thornton, President, Canadian National Railways

machine, but as a rule comes back enthusiastic for the new equipment. In this way, both the foremen and men get an idea as to how the machine is performing in other shops.

Unless a machine is "sold" to the men who are to use it, there is little chance of its being as great a success as it should be, so that it will pay for its installation. Our shops have been fortunate in securing the cooperation of the men, who take pride in the performance of the machine equipment, and in reducing costs. Invariably one will find that the operator of a machine will welcome an opportunity of showing that he can get as much out of a machine as anyone else. This cooperation reflects credit on the management, since it indicates very clearly complete confidence in the fairness of those in charge of the shops.

Getting the most out of machine tools depends on more than picking the right machine and buying it at the right price; it depends on getting the machine tool into the hands of an operator who wants it to succeed, and who has a real interest in its performance.

* * *

BORING MILL TIRE CLAMPS

By J. R. PHELPS, San Bernardino Shops, Atchison, Topeka & Santa Fe Railway, San Bernardino, Cal.

An improved design of clamps for holding tires on a boring mill table is shown in Fig. 1. The foot A of this clamp engages a slot in the table, and as this foot can be placed beneath the tire, a direct downward pull is obtained. Furthermore, this style of clamp eliminates all blocks and bolts and facilitates clamping a tire quickly. One-inch set-screws B provide the clamping pressure. Three of these clamps are used. These are, of course, equally spaced about the tire, and between them there are three locating blocks similar to the one

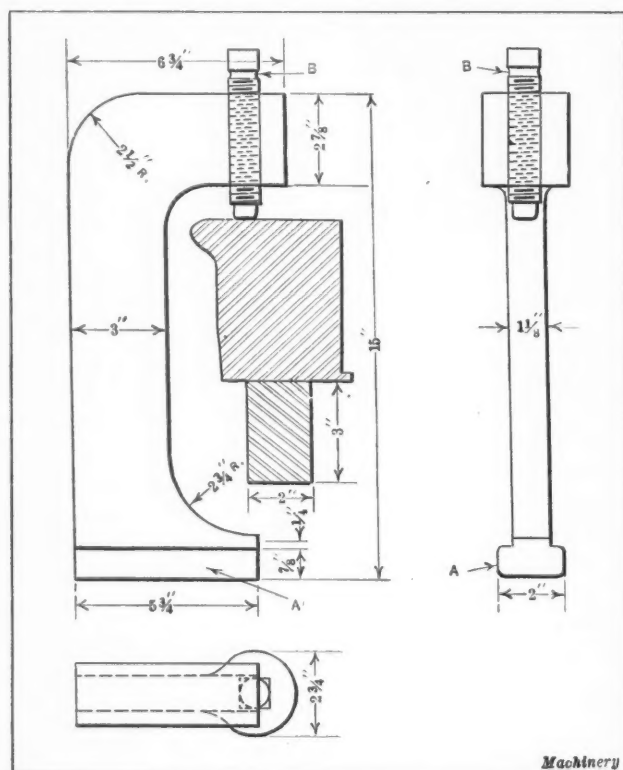


Fig. 1. Clamp Used for Holding Tire Down on Supporting Parallel

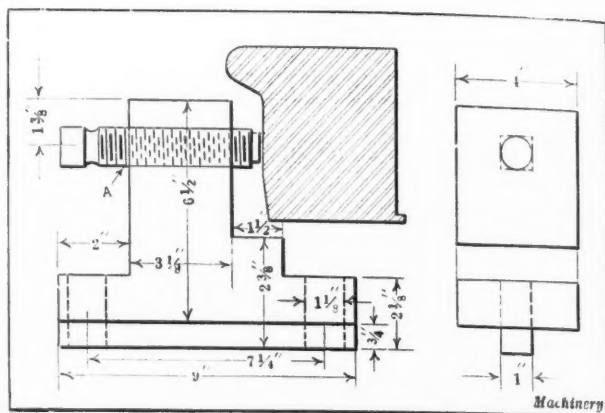


Fig. 2. Locating Block Used in Centering Tire on Boring Mill Table

shown in Fig. 2. These blocks are used for setting the tire central, the one-inch set-screws A providing the adjustment.

* * *

MACHINERY DISTRIBUTORS' MEETING

The twenty-third annual convention of the National Supply and Machinery Distributors' Association was held at the Hotel Hermitage, Nashville, Tenn., May 15 to 17, in conjunction with the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association.

The first meeting opened with the annual address of the president of the National Supply and Machinery Distributors' Association, E. P. Welles, president of Charles H. Besly & Co., Chicago, Ill. This was followed by the annual report of the secretary-treasurer, George A. Fernley, after which a discussion was introduced on the subject "Business at a Profit Rather than Profitless Prosperity."

Among other subjects discussed during the meeting were "Can Supplies be Distributed on a Gross Margin of from 15 to 16 Per Cent, as Some Manufacturers Allege?"; "How Frequently Should Salesmen Call on Customers?"; "What is the Value to the Industry of Resale Price Maintenance?"; "The Inefficiencies of Direct Selling by Manufacturers, and the Ability of Local Distributors to Render Service Superior to that of Distant Manufacturers"; "Are Manufacturers Using Too Many Outlets for Their Products?"; and "Is the Distributor Performing Too Many Services for which he Receives Little or No Compensation?"

In addition, an address was given by Charles E. Curtis, president of the Western Iron Stores Co., Milwaukee, Wis., on "What Distributors Can Do to Convince Customers of the Advisability of Buying Locally." Another address was given by L. V. Benjamin, vice-president of the Rowell Mfg. Co., Appleton, Wis., on "The Economic Importance of the Distributor to Manufacturers and Industrial Consumers."

* * *

It is believed that the three oldest pieces of wrought iron in existence are two sickle blades found in Egypt, which are about 5000 years old, and a portion of a cross-cut saw which must have been made some time previous to 880 B. C., although how long before that date it is impossible to estimate.

How We Reduced Our Labor Turnover

By MARISTAN CHAPMAN

WHILE a great deal of time and money are being spent on research relating to manufacturing processes, the handling of raw materials, routing of work, and other shop problems, a definite labor policy is often neglected in many shops. Yet a well thought out labor policy is the cornerstone of an organization, and labor is the final factor on which the success of improved methods in all other directions depends.

The present article describes the experience of a large company in the Middle West that grappled with the intangible costs of a high labor turnover. In this plant it was not at first understood that labor turnover is a "group" factor. It has to be solved through general policies working down to the individual, rather than by attempting to consider each man's case as an individual problem. The stress in this plant had for a long time been on intensive individual training, but a great deal of this effort was wasted because of the drifting stream of workers.

The First Step is to Find the Reasons for High Labor Turnover

The first step, therefore, is to analyze the reasons for high labor turnover and classify them. The methods to be described were the ones followed in the plant referred to. We recorded the number of men discharged for manual inefficiency, the number discharged for moral defects, the number who left of their own volition (with the most common reasons given in each case), and the number of those injured in the course of work.

The most serious effect of our high labor turnover was waste and high material costs. More than this, we found that we were losing on our extraneous departments (educational, welfare, sports, etc.), because no results could be obtained from the educational effort expended on a constantly shifting personnel; the welfare department served only to equip workers for jobs with other concerns; and our sports organization lacked enthusiasm because interest flagged as new men frequently took the place of old players.

Upon investigation, we found that we were losing the greatest percentage of our employees within the first few weeks after they were hired. This showed us that either our hiring system or our "breaking in" method was at fault. It further indicated that the longer the duration of employment of a workman, the less likely he is to change.

We discovered that our labor turnover was of two kinds: Seasonal, due to changes in manufacturing and raw material conditions; and general, or "year-round" turnover, due to dissatisfaction or restlessness of the workers. The first was governed by the firm's policy; and the second was controllable by the employment of a class of labor susceptible to educational effort by the firm.

How the Most Serious Causes of High Labor Turnover were Overcome

Other facts that came to light were:

1. In years of depression newly hired men would "stick"; in years of prosperity they would leave after a short period, as there was always plenty of work to be had at good wages. Obviously the thing to do was to convince the men that every year with us meant prosperity for them—that the habit of shifting about when work was plentiful and money easy militated against their own ultimate prosperity. This we did in a series of ten-minute talks by our assistant manager, who made many converts to the idea of becoming a "steady." This educational effort was helped by the old hands who had weathered several cycles of depression and prosperity with us and who were convinced that it pays to stick. Direct educational effort seems to be the only successful method of combatting the shifting habit.

2. The turnover among new men is not confined to any particular class of workers. Regardless of the nature of the work, or grade of skill, they tend to leave during the first few weeks. If this unsettled period is successfully handled and the workman established, he will most likely go on for a long period. We have found that it pays better to employ "break-in" instructors for new men, instead of using our foremen's time for this work. This is a matter that every firm must determine for itself, the size of the plant, the nature of the work, etc., being variable factors. In general, a man whose special business it is to break in new hands will have more patience than a foreman who often looks on new employees as an extra burden.

3. After the first few weeks (the try-out period) records showed a difference in the rate of turnover in various departments. The turnover generally was low among skilled operatives and brain workers, and high among yard laborers. It was high among the automatic machine operators, possibly because the monotony of the work

A well thought out policy for hiring and retaining employees is the cornerstone on which many organizations have built their success. A large labor turnover seriously handicaps a manufacturer and indicates dissatisfaction among a large number of workers. Careful consideration of the reasons for frequent changes among the employees in a plant may reveal conditions that can be easily remedied, to the mutual benefit of both employer and employees. This article describes what was accomplished by a large concern in the Middle West. Several causes of high labor turnover that often escape notice are pointed out, and the means employed for successfully overcoming the difficulties encountered are described. Every shop manager, superintendent, and foreman will find something in this article applicable to his own shop.

could only be compensated for by changes of locality.

There was a high percentage of turnover on the unattractive jobs. Some jobs are essentially hot, heavy, and dirty, and as we could not change the nature of the jobs, we had to make them more attractive by better pay. We paid slightly more on our "ugly" jobs than could be obtained for similar work elsewhere, and thus lowered our turnover in this field.

The problem of the automatic machine operators was a difficult one. Higher pay was wasted on them, for the monotonous nature of the work proved a stronger factor. The difficulty was overcome by hiring less experienced or lower paid workers. It had always been our policy to hire the most experienced workers obtainable, and it surprised us to find that sometimes this is a mistake. A study of facts may lead to the unexpected.

We were employing men on our punch presses who had training that fitted them for more difficult or advanced work, and being ambitious, they were taking this work only when temporarily out of a job. Consequently, we were paying high wages to a constantly shifting force, losing on the pay sheet and on the cost of breaking in new men as well. When we learned to employ less ambitious workers, we found them content to go on indefinitely with this work, which brought them satisfactory pay.

It is a serious problem in modern industry that jobs in which there is little opportunity for the worker to increase his skill or knowledge are on the increase, but at present, there is a plentiful supply of labor for such

work, which is an advantage to all. However, this problem is one that must be faced sooner or later, and serious thought must be given to it.

A Man Hired for Less Than His Former Pay will Soon Leave

The first axiom of our hiring methods has always been that the job we offer must pay the applicant as much as he got on his last job or, if possible, more. If it pays less, the man may come to us in his emergency, but he comes prepared to leave the instant he sees a chance to better himself. His roving eye is always on the other job. After studying the labor turnover problem, we strengthened our policy of filling vacancies from within the plant. It shows the workmen that they have an opportunity for advancement. Discontented men on the verge of leaving can often be placed to advantage in some other department where they will prove valuable.

Employees that Leave or are Discharged

The leaving of employees and the discharging of men is a matter so governed by seasonal fluctuations, nature of the trade, and other factors that

only the methods applicable to our case can be recorded for what they are worth.

All men leaving on their own initiative are interviewed by the employment department, and often are persuaded to remain. This practice prevents the loss of good workmen who leave in a fit of anger or as the result of a grudge against their foreman or fellow-workmen.

No worker can be discharged without the consent of the employment department. This is an effectual check on foremen who bear grudges, or, through ignorance of the general factory conditions, get rid of men that the firm might profitably use in another place. It is a check, too, on racial and religious prejudices that tend to form "cliques." A large percentage of our rapid turnover was traced to one foreman who was "hard to please" and "grouchy." He was an old hand, zealous for the firm, and insistent in his demand for high-grade work, but

until we adopted the employment department check on discharging, he was a source of loss through his hasty and indiscriminate firing.

A poor system of discharging workmen not only permits good men to get away for a trifling cause, but gives the firm a bad name that prevents the better class of workmen from applying.

The Cost of Hiring and Firing

This is not the place to outline a cost accounting system, for methods necessarily vary with local conditions and with different trades, but a brief account of our experience will show where to look for trouble. A little experimenting will convince any employer that it costs less to reduce labor turnover than it does to put up with it.

The cost of breaking in new men divides itself into two parts: First, the amount the employer can invest in breaking in new men is limited by the rate of labor turnover; and, second, the amount invested in training new hands controls the output the employer can expect from each workman.

The simple cost of hiring includes employment department salaries, advertising, and, in some cases, medical examination; the cost of breaking in must be divided under four heads:

1. Value of foreman's time spent on new workers, or salary of special instructors.

2. Labor cost. The day wages of a new man generally exceed his piece-work production until he is trained; on a time basis, the new worker costs more because he takes longer than the normal time to do a given piece of work.

3. Cost of materials. Wear and tear on machines, due to inexperience and inexpertness of new men; cost of work spoiled; and cost of repairs for machine and tool breakage.

4. Cost of accidents, which are always greater among learners.

A high labor turnover results in high accident insurance premiums. It affects taxes, interest, de-

preciation, and repairs, owing to lessened output of the plant and hard usage of machinery. The cost of breaking in new men must be balanced against the amount that the employer can afford to spend to reduce labor turnover. It should also always be remembered that seasonal fluctuations fall not only on the employer, but on the men themselves, and their period of unemployment is unproductive for the industry and the nation as a whole.

An Analysis of the Causes of Labor Turnover

The causes of labor turnover may be roughly divided into those pertaining to the job, those pertaining to the men, and differences between men and management. The last is the most difficult to define and to correct, for the differences in point of view between the firm and the new employee are infinite, and range all the way from wages to factory location.

Some of the things to be considered under this last head are: Nature of the work (it may be heavy or disagreeable compared to other jobs that can be found in the neighborhood); slow advancement; too low wages; inaccessibility of factory; better opportunities in other plants.

In the matter of local conditions, we found ourselves handicapped by the fact that there were several other factories similar to ours in the same section. Our plant is in a congested working district and the general living conditions are not attractive to the workman's family, and there are few educational advantages for his children. All these factors had to be combatted when we searched for high-class labor. With other firms the isolation of the plant may prove a disadvantage.

Our point of view became a good deal more flexible when, in the course of studying local conditions, we ceased to consider the workers solely as units of the firm and regarded them also as social and economic units. It broadened our understanding of the workman's attitude.

The reputation a firm bears for safe machines and satisfactory accident insurance settlements is a big factor in labor turnover. We rated high here, but we found it paid, none the less, to stress these factors.

To sum up, we found that the fundamentals for reducing labor turnover were an efficient hiring system, good wages, steady work, short hours, healthful and safe factory conditions, and careful consideration of facts before discharging a workman. Wages and hours may or may not be within the control of the individual small employer, but the mitigation of unpleasant working conditions usually is, as is also partially the problem of steady work, for by efficient organization and careful planning, it may be possible to hold workers over periods of depression and prevent heavy turnover due to seasonal fluctuation.

BRITISH MACHINE TOOL IMPORTS

Distributors of American machinery in Great Britain state, according to Trade Commissioner William M. Park, of London, that 1927 proved a much better year than 1926 with respect to sales volume. Statistics published by the Department of Commerce show that the value of machine tools imported from the United States rose from approximately \$2,300,000 in 1925 to \$2,900,000 in 1926, and \$3,700,000 in 1927.

In tonnage, Germany exported a larger volume of machine tools to the United Kingdom than the United States, but the value of the exports from the United States was more than twice the value of those from Germany. This fact illustrates clearly the market situation—American tools, because of their high quality, find a ready market in competi-

tion with machines built elsewhere, despite the fact that the latter are considerably cheaper. The average value per ton of machine tools imported from the United States in 1927 was approximately \$1100, as compared with only \$450 for German equipment, and \$650 for equipment from other countries. Among American machine tools for which there has been a good sale are mentioned milling machines, grinding machines, crankshaft production machines, balancing machines, and cylinder honing machines.

The bulk of the machine tools imported into Great Britain from the United States is absorbed largely by a few industries, the automobile industry ranking first. There are in Great Britain at present sixty-six manufac-

Does it Pay to Train Apprentices?

The question has been asked "Is it possible to train enough men within an organization to meet the needs of the plant, not only for skilled shop men but also for executive positions in the shop, sales, and other departments?" In July MACHINERY, General Otto H. Falk, president of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., answers this question on the basis of the experience of the Allis-Chalmers company, over a period of a great many years. At this plant, over 300 boys and young men are being trained at all times in regular supervised courses intended to fit them for some line of work necessary in the conduct of a large manufacturing establishment. The article answers the question "Is the present-day apprentice system a success?"

turers making passenger cars and forty-six makers of automobile trucks. In addition to these British manufacturers, several American, French, and Italian firms have assembling plants in Great Britain in which a large quantity of machine tools are employed.

The total output of automotive vehicles, approximately 160,000 passenger cars and 70,000 trucks in 1927, places Great Britain in the second place as a world producer in the automotive field. In addition, the British production of motorcycles is the greatest in the world, averaging about 120,000 annually. Over 600,000 motorcycles and 10,000,000 bicycles are in use in the United Kingdom, and the manufacturers of this equipment are large buyers of machine tools, as are also the electrical industries.

* * *

An interesting item in *Construction News* mentions that Walter Bates, president of the Walter Bates Steel Corporation at Gary, Ind., is building a house entirely from steel and concrete without any wood whatever in it. The floors are made of concrete slabs, the framework is made of all-steel construction, and the stairs and window sash are all of steel.

Chromium-plating Metal-working Tools

By P. CATUCCI, President and Chief Engineer, Meisselbach-Catucci Mfg. Co., Newark, N. J.

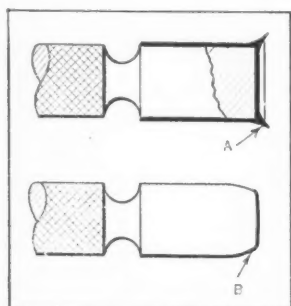


Fig. 1. Showing Building-out Characteristic of Chromium-plate

CHRONIUM - PLATING, when properly done, forms a protective coating which is highly resistant to wear and corrosion. In appearance, it closely resembles nickel-plating, although when directly compared, chromium-plating appears to have a blue tinge and nickel-plating a light straw tinge. Chromium-plating is harder than steel, and

has been successfully employed to increase the life of metal-cutting tools. It can be applied to practically all commonly used metals, with the exception of silver and aluminum, and even aluminum alloy die-castings of certain compositions have been successfully plated with chromium.

Only two acids, muriatic and hydrochloric, attack chromium-plating, and its bright lustrous finish is unaffected by heat up to temperatures of 700 degrees F. The melting point is about 3000 degrees F. Ability to resist corrosion and remain untarnished when continually exposed to salt water and salt air make chromium-plating a desirable finish for boat fittings. It has also proved an ideal finish for automobile radiators, lamps, bumpers, etc. Mud and water do not adhere readily to chromium-plating, which comes out as bright and lustrous as new when simply washed with water, even when mud and dirt have been allowed to accumulate for many weeks.

The ability of chromium-plating to resist the corrosive action of phenol is well illustrated by a test made by a manufacturer for whom the Meisselbach-Catucci Co. had chromium-plated some metal-cutting tools. A high-speed steel forming tool which had been chromium-plated on the cutting end was placed in a pot containing a highly corrosive phenol mixture in plastic form. This was done to determine the amount of protection afforded by the plating. When examined later, it was discovered that the high-speed steel had been attacked from the unprotected end and eaten away, leaving the thin shell of chromium-plating intact.

Hardness of Chromium Plate

Although it is difficult to gage accurately the hardness of chromium-plating, scratch tests indicate that it has about the same hardness as the sapphire. The effective hardness, however, depends on the metal to which it is applied. Soft metals, such as copper, are easily deformed under pressure, and therefore permit the thin chromium-plating to break down under less pressure than when applied to harder metals. It is estimated that the chromium-plating itself is several times as hard as nickel-plating. Glass can be readily scratched with

the edge of a piece of brass strip stock which has been chromium-plated, whereas a similar piece which has been nickel-plated will simply slide over the glass.

Chromium-plated Cutting Tools Show Greatly Increased Resistance to Wear

Metal-cutting tools which have been built up on their cutting edges by chromium-plating have given excellent results. A 3/16-inch reamer used for reaming holes in a monel metal part, for instance, was brought up to the required size by chromium-plating. In this case, 0.001 inch of metal was added. The reamer thus treated shows no sign of wear, even though it has already produced several times as much work as the best reamer previously obtainable.

Among the various types of cutting tools that have been chromium-plated are taps and forming tools. Manufacturers of bakelite and other phenol products have, in some instances, found it profitable to have their cutting tools chromium-plated. The hardness, resistance to corrosion, and smooth finish of chromium-plating, which lessens chip clogging, makes chromium-plated taps especially well adapted for use on bakelite parts.

Chromium-plated files have proved excellent for use on soft metals, as they do not clog or load up as quickly as unplated files, and they hold their edge exceptionally well. Although the chromium-plating of metal-cutting tools, to increase their life or build up their cutting edges when worn, has not yet been extensively adopted, the results obtained in certain cases have been very promising, and indicate that chromium-plating may soon become an important factor in the production and maintenance of cutting tools for certain metals and non-metallic materials.

Dies and Metal Spinning Tools

Dies for molding or forming bakelite products of simple form, such as buttons, have been found to give longer service and produce a better finish when chromium-plated. The depth of plating for dies of this kind is about 0.002 inch. The low coefficient of friction of chromium-plated surfaces undoubtedly contributes much to the success of certain metal-cutting or metal-working tools, such as punches and dies for drawing seamless tubes and shells.

Chromium-plated rivet spinning tools used in the Meisselbach-Catucci plant have been found to stand up from ten to fifteen times longer than the hardest unplated steel tools. Tools for this kind of work are made up in lots of a dozen or more. Occasionally one of the tools does not stand up as well as the others for some unexplained reason, but when the tools are made up in lots of a dozen or more, the failure of one tool to give maximum service is of little consequence.

Building up Worn Plug Gages

Plug gages that have been worn under size can be built up by chromium-plating and then lapped to size. Any amount of metal up to 0.004 or 0.005 inch can be added to a worn gage. On work of this kind, a peculiar characteristic of chromium-plating is observed, namely the tendency of the plating to build out at the corners or edges, as indicated by the greatly exaggerated solid black section at A, Fig. 1. To counteract this, the end of the plug gage to be plated is sometimes modified, as indicated at B, so that less lapping will be required to bring it to the exact size.

The building-out action of chromium-plating is opposite to that of nickel-plating, which has a tendency to draw away from corners or edges. In some cases the building-out action is taken into consideration in making forming dies which are to be chromium-plated. For instance, the shape of a fine decorative beading may be changed or the edge of some part of the die may be rounded to compensate for the tendency of the metal to build up faster on these surfaces. Chromium oxide is used in lapping chromium-plated gages, or other parts, to size and in polishing. When the chromium-plating of a plug gage has worn under size, it is removed by subjecting it to the action of muriatic acid. The gage is then built up again by chromium-plating and lapped to size. When removing the worn plating, the gage is carefully watched and the action of the acid stopped as soon as the plating has been removed, in order to avoid the roughening effect of the acid on the steel.

Experience is a Necessary Factor

The process of chromium-plating is similar to nickel-plating, although greater care in handling the plating equipment is necessary. Also a better knowledge of the chemical, electrical, and metallurgical properties of the materials involved is essential. Considerable practice is generally required before the operator can obtain the desired results. In fact, the first attempts at this work are likely to be rather discouraging.

The Meisselbach-Catucci Mfg. Co. has developed its equipment and methods of handling chromium-plating work to their present state of satisfactory operation on commercial job work only after conducting a great amount of experimental work and making practical application of the knowledge

gained in handling a great variety of plating jobs. Every new job has its own peculiar problem. Many small-lot jobs have been handled at a loss, due to the amount of experimental work performed in an effort to obtain the best results possible. However, the knowledge or data obtained in dealing with such a variety of work is a valuable asset of the chromium-plating department which could have been obtained in no other way.

Cleaning Work to be Plated

Work that is to be chromium-plated must be clean and free from dirt or grease, the same as when any other finish is to be applied. Parts that have been cleaned for finishing by nickel-plating or painting are generally sufficiently well prepared for chromium-plating. An effective method of cleaning greasy or dirt covered parts is to wash them in a 5 per cent sulphuric acid solution.

In Fig. 2, is shown diagrammatically the arrangement of a tank employed for chromium-plating. The size of the tank depends, of course, on the size or the amount of work to be plated. The tank is lead-lined and provided with steam heating coils or pipes (not shown), which are located inside the tank and near the bottom. The chromic acid solution used for chromium-plating

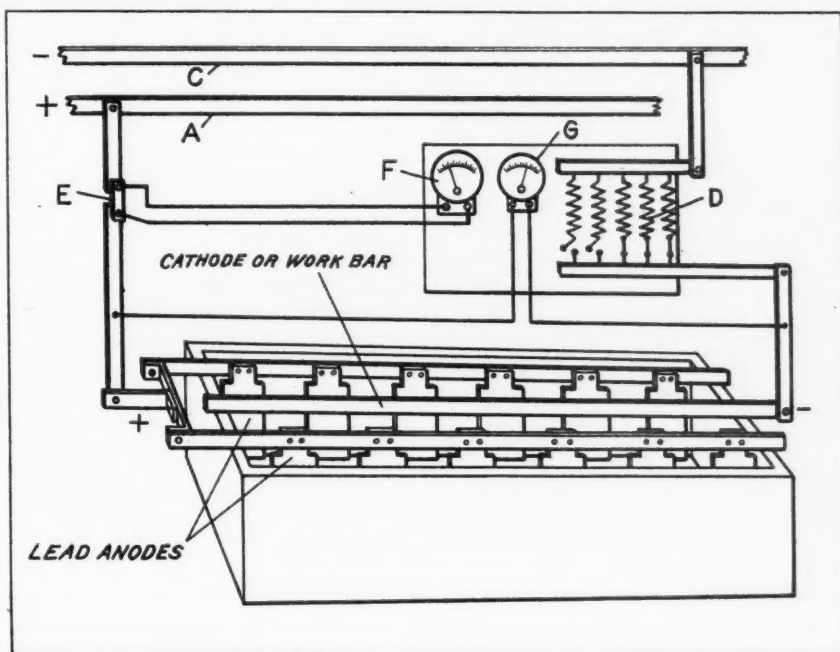


Fig. 2. Diagram of Chromium-plating Tank and Equipment

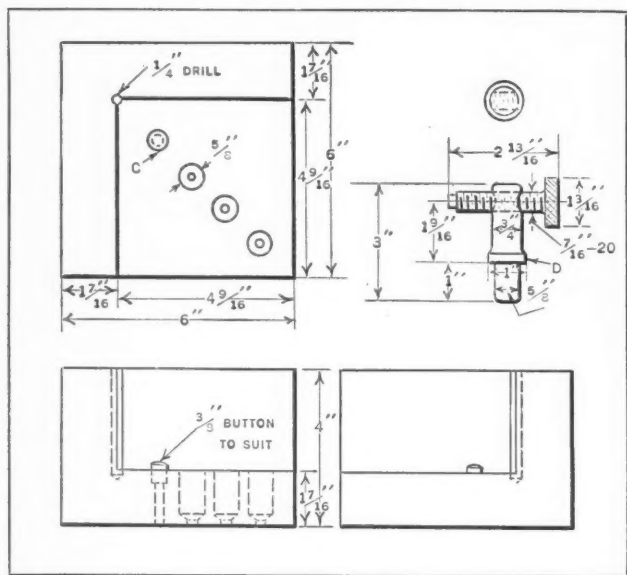
is kept at a temperature of from 105 to 115 degrees F. by the steam coil. A hood (not shown) which is connected to an exhaust system carries away the poisonous fumes generated during the plating operation.

Electric Current Requirements

The electric current is supplied by a motor-generator outfit, the motor of which is operated from the public service line. This motor drives the generator that supplies the electric current for the plating tanks. The current is carried to the various plating tanks by the heavy copper bus-bars A and C. The lead anodes are attached to heavy copper bars at each side of the tank which, in turn, are connected with the positive or plus (+) bus-bar A. The bar from which the work is suspended in the plating solution by wires or baskets is connected with the negative or minus bar C through the resistances at D which control the amount of current used.

Direct current is supplied at about 6 volts, and the amperage or current consumption is regulated

The voltmeter G is connected across the bus-bar leads, one wire being attached to the anode or pos-



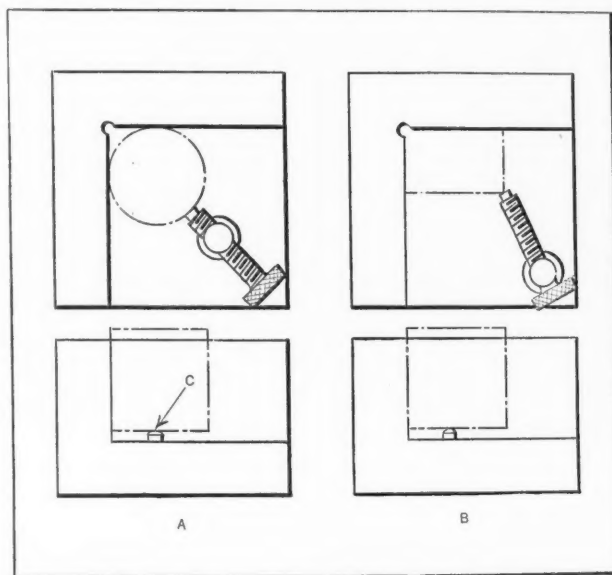
itive side and the other to the negative or work-bar side. All plating tanks are equipped with an ammeter, voltmeter, and variable resistance control or rheostat, as indicated in the diagram Fig. 2. On being removed from the plating tank, chromium-plated parts are washed in tanks of hot water until they are entirely free from the chromic acid of the plating bath.

The cost of chromium-plating is generally two or three times that of nickel-plating on ordinary small-lot work. For some classes of work handled on a regular production basis, however, the cost may not be more than 25 per cent greater than for nickel. In some cases, work is done on a piece-rate system. One job handled in this way is the plating of locks, the price being 1 1/2 cents per lock.

The cost of chromium-plating, however, may be considered a small item in the total production cost of many articles, considering its protecting or wearing qualities. Such products as copper master records for molding phonograph records have been chromium-plated to give them greater resistance to wear and the corrosive action of the material from which they are made. The advantages obtained by chromium-plating such products as surgical instruments, instrument gears, and brass water pipe fittings, indicate that hundreds of similar products may be greatly improved by this process.

* * *

The fixture shown in Figs. 1 and 2 not only saves time but also insures accuracy in handling many small grinding jobs in the plant where it is used.



This fixture is now employed for a variety of work that was formerly mounted on a regular angle-plate. With the angle-plate method, it was often necessary to line up the work two ways in order to grind the required surfaces, whereas with the new fixture no realigning is required.

The view at *A*, Fig. 2, shows how a cylindrical piece is held, and the view at *B*, the method of holding a rectangular piece. With this fixture and method of holding the work, it is possible to grind a piece square on two sides. The fixture has been found particularly useful in grinding quantities of hardened dies that are required to have parallel surfaces.

Electric Drives for Machine Tools

By GORDON FOX, Electrical Engineer, and ARTHUR J. WHITCOMB, Assistant Electrical Engineer, Freyn Engineering Co., Chicago, Ill.

ELECTRIC motor drive enjoys well deserved popularity, and is now almost universally employed for machine tool operation. There are many contributory reasons for this, the principal ones being: Freedom in location of machines; reliability; increased production, due to controllability and speed maintenance; independence of machines; crane access; and improved working conditions.

Machine tools vary widely in their functions. They may be broadly classified, however, as rotary or reciprocating. The lathe, boring mill, and drill press are examples of rotary machines, while the planer, shaper, and slotter are examples of reciprocating machines.

Power Requirements

The load demand upon a motor driving a rotary machine is made up of machine friction plus the power required to remove the metal. The relative values of these two items vary. The load demand of a reciprocating tool involves the same items and, in addition, the power required to start, stop,

and reverse the reciprocating parts. The load of a rotary machine may be quite constant, as in the case of a lathe making a continuous cut. If the cut is not continuous, the load may fluctuate considerably. The load of a reciprocating machine is inherently of a fluctuating nature, and the reversing peaks may be an important or determining factor.

The frictional load of a machine tool depends upon its design, and cannot be determined by formula. It may be best found by test. The power required to remove metal depends upon the character of the metal, rate of removal, average thickness of chip before distortion, and type and condition of tool. The following figures are widely used for lathes, shapers, boring mills, and planers:

Power Required to Remove Metal

Material	Horsepower Required to Remove 1 Cubic Inch per Minute
Brass	0.2 to 0.3
Cast iron	0.3 to 0.5
Wrought iron	0.6
Mild steel (0.30 to 0.40 carbon) ..	0.6
Hard steel (0.50 carbon)	1.00 to 1.25
Very hard tire steel	1.5

The power required for drilling is about double that given in the table, due largely to friction between the drill and the side of the hole.

Heavy cuts requiring high torques are usually taken at relatively low speeds, while lighter cuts are taken at higher speeds. Thus the load tends toward a constant horsepower characteristic.

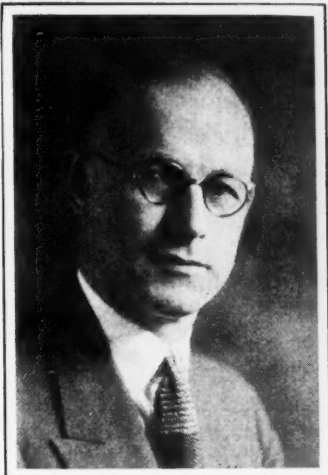
Motor Characteristics

Machine tools are sufficiently varied in their requirements so that several types of motors find application in individual cases. A considerable portion of the total field requires a constant-speed drive with no unusual features. Here the direct-

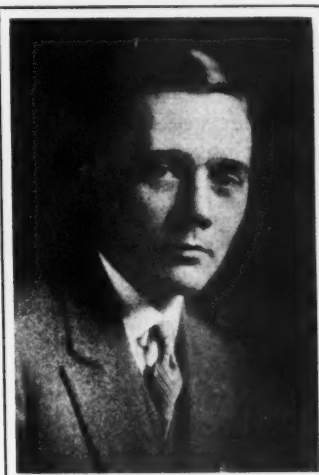
current, shunt motor or the alternating-current, squirrel-cage induction motor may be used with equal success. Either type will effect some gain over constant-speed belt drive from a lineshaft.

Many machine tools require adjustment of speeds over varied ranges, some as high as 30 to 1. Adjustable-speed direct-current motors are inherently best suited to such machine tools, and their general use should be encouraged. Some machines, such as punches and shears, particularly when equipped with flywheels, require high starting and pull-out torque, together with drooping speed regulation. Here the compound-wound, direct-current motor or the high-slip induction motor is applicable.

Owing to the fact that alternating current is



Gordon Fox



Arthur J. Whitcomb

GORDON FOX, one of the co-authors of a series of articles on "Electric Drives for Machine Tools," the first installment of which is here presented, has had a wide experience in the electrical field. After graduating from the University of Wisconsin in 1908, he became connected with the General Electric Co. at Fort Wayne, Ind., where he spent five years in the service and sales departments, his last position being that of sales engineer, specializing in motor application. Subsequently, he became associated with the Steel & Tube Co. of America in the capacity of electrical engineer, and during his seven years connection with that company he had charge of the electrical design, construction, and initial operation of a large coke-oven, blast furnace, and steel works at Indiana Harbor. For the last seven years he has been electrical engineer in the consulting engineering organization Freyn Engineering Co., which specializes in the steel industry and industrial power fields. Mr. Fox has written many articles for the technical press, and is the author of a book, "Principles of Electric Motors and Control." He is a member of the Association of Iron and Steel Electrical Engineers, the American Institute of Electrical Engineers, and the Western Society of Engineers.

ARTHUR J. WHITCOMB, co-author with Mr. Fox of this series of articles, graduated from the University of North Dakota in 1916. He entered the Westinghouse Electric & Mfg. Co. as an apprentice and later became a service and erection engineer. During the World War, he was connected with the Coast Artillery Corps, serving, successively, as private, electrician sergeant and second lieutenant. At the close of the war he returned to the Westinghouse Electric & Mfg. Co. as service engineer, specializing on steel mills. In 1919 he joined the Steel & Tube Co. of America at its Indiana Harbor (Ind.) plant, and for three years served both in the electrical engineering department and in the electrical operating department. In 1923 he became assistant electrical engineer of the Wisconsin Steel Co. In 1924 he joined the McGraw-Hill Publishing Co. as associate editor of the *Industrial Engineer*, specializing in the electrical operation of mills and factories. Since 1926 he has been connected with the Freyn Engineering Co. as assistant electrical engineer. Mr. Whitcomb has contributed many articles to the technical press, and is a member of the Association of Iron and Steel Electrical Engineers and the American Institute of Electrical Engineers.

more commonly available, particularly in the smaller shops, the manufacturers of machine tools have adopted extensively the use of the gear-box for speed changes, thus adapting their tools for induction motor drive. For reasons of standardization, the same tools are then offered for use with constant-speed, direct-current motors, where the latter current is available. From the viewpoint of the machine tool builder, this standardization is desirable. In many cases, particularly for small machines, the practice is commendable. Where direct current is available, however, it will often benefit the user to employ adjustable-speed motors and eliminate the gear-box, or greatly reduce the number of change-gears required.

The adjustable-speed direct-current motor is excellently suited to the requirements of many machine tools. Owing to varying diameters, materials, and cuts, it is necessary to operate over a wide range of speeds. A selection of speeds can be had by the use of cone pulleys, while a greater number is available by the use of a gear-box. The adjustable-speed motor provides a finely graduated selection of speeds over a range up to 4 to 1. If a wider range is desired, a simple set of change-gears will suffice to extend the range.

The great advantage to be derived from the use of the adjustable-speed, direct-current motor lies in the fact that maximum permissible cutting speeds may be maintained and the speed may be readily manipulated. When speed changes must be made in sizable increments, it is necessary to use a speed lower than but approaching the desired rate. The margin represents a direct loss of production. Increased production has the double aspect of lower unit cost and less time required, lowering the overhead and facilitating good deliveries and quick repairs.

It is not to be inferred that adjustable-speed, direct-current motors should be universally applied. When speed control features are unnecessary and a constant speed is satisfactory, the induction motor can be used to advantage. Records indicate that induction motors are somewhat more free from troubles and require less repairs than direct-current motors. It is perfectly possible to have an equipment of direct-current motors and control, if properly selected and applied and properly maintained, that will require few repairs. An induction motor, improperly applied or neglected, will stand up better than a direct-current motor under like conditions. It must also be considered that more is usually expected of the direct-current motor and control in the way of starting, stopping, reversing, and speed control, and the machine itself is thereby simplified and its maintenance and depreciation decreased.

In some cases, both alternating- and direct-current power supplies are available. In other cases, alternating current only or direct current only is available. Under the latter conditions, direct-current motors will be used exclusively. In a small shop where alternating current only is available, it is ordinarily best to use constant-speed, induction motors, foregoing the advantage of adjustable speed to avoid conversion. For larger shops, it may be advisable to install a converter or a motor-generator to supply direct current for all

or a portion of the machines. The use of both alternating-current and direct-current motors in the same shop may or may not be advisable. When a number of large, constant-speed drives are required, alternating current should be used if available, even if a mixed installation results. If there are but a few constant-speed drives, direct-current motors may well be used for the sake of uniformity and to avoid two systems of current distribution. In some cases, direct-current motors have advantages in controllability even for constant-speed drives.

Group and Individual Drive

Machine tools may be driven by independent motors or several machines may be grouped and belt-driven from a lineshaft driven by a common motor. Both arrangements have their place. The tendency is toward individual drives, due largely to advantages in flexibility of location and operation and elimination of lineshafting. Group drive enables the use of a lesser motor capacity having 25 to 75 per cent of the combined requirements of the driven machines, depending upon the number of machines, relative sizes, and diversity of operation. Group drive is particularly advantageous in this respect where fluctuating loads are involved, as the fluctuations are relatively less when referred to the larger motor. Group drive is well suited for driving a number of small machines which are associated and naturally located together. Individual drive is particularly desirable when independent controllability is desired, when adjustable speed is required, for machines rather widely scattered, and for all large machines.

In many cases, on the larger machines, such as planers, boring mills, high-duty milling machines, radial drills, and the like, individual drive has been carried to the extent of using two or more motors on a single machine. In addition to the main drive motor, small motors, usually of the series or heavily compound type, are provided to drive the feed mechanisms.

Motor Location

A rather important feature in the application of motors to machine tools is the question of location and connection of the motor. Motors should be located where they will not be exposed to damage in the handling or transport of materials. The motor should be substantially mounted. It should be mounted as near as possible to the actual point of power consumption, so as to eliminate intermediate mechanism so far as possible. The mounting arrangement should be adaptable to a variety of makes and types of motor. This facilitates substitution in case of trouble.

Lack of proper physical protection has contributed to many a motor failure. The motor should not be exposed to chips, dirt, or oil. Totally enclosing covers on the upper half of direct-current motors should be used for all except the least exposed installations. Motors should be well balanced, to avoid vibration, which hastens depreciation and may affect the finish of the work. It is preferable to avoid too high motor speeds, particularly with direct-current motors.

There is a trend toward incorporating the motor as an integral part of the machine tool. A number

of machines have been developed with the motor mounted in the pedestal, housing, or on the frame in the rear of the machine. Such an arrangement is compact and neat in appearance. However, in adopting this design, careful consideration must be given to ventilation. Attention must also be given to the placing of hand-hole covers to afford access to the motor, as well as to the ability to remove the motor readily in case of breakdown.

Several advantages are gained by designing the machine tool to incorporate both the motor and

Load and Speed Ratings for Machine Tool Motors

Horse-power	3 to 1 Ratio	4 to 1 Ratio
	R. P. M.	R. P. M.
2	700-2100	500-2000
3	650-1950	500-2000
5	650-1950	450-1800
7 1/2	600-1800	450-1800
10	600-1800	400-1600
15	550-1650	400-1600
20	500-1500	400-1600
25	500-1500	400-1600
35	500-1500	300-1200
50	400-1200	300-1200

control: The proper motor and control can be built into the machine at the time of manufacture; the conduit can be run inside the frame where it is most safe and protected and where it does not mar the general appearance; the machine can be assembled, wired, and tested as a complete self-contained unit; when the machine is installed, the only wiring required will be the running of line leads to it.

Standardization of Electric Equipment

Machine tools are commonly purchased with motors and control. A shop containing a number of such machines may bear semblance to a museum in that a great variety of types of electrical apparatus will probably be represented. It is highly desirable that the variety of types and sizes of motors and controls be restricted, wherever possible, so that equipment may be interchangeable and a minimum of repair parts required. A shop of any size should have its purchases of electrical equipment supervised with a view to obtaining the most practical equipment both from an operating and maintenance viewpoint.

Motor Ratings for Machine Tool Service

Machine tool duty is not considered as continuous, but is more or less interrupted or varying. For this reason, adjustable-speed, direct-current motors are given a special intermittent rating known as the machine tool rating. This is the 60-minute rating on a 50-degree C. rise basis, open or semi-enclosed, and on a 55-degree C. rise basis, totally enclosed. The motor nameplate carries, in addition, a continuous-duty 50-degree C. rise horsepower rating.

The standard horsepower and speed ratings for adjustable-speed machine tool motors are given in the accompanying table.

Control for Machine Tools

Inasmuch as controllability is one of the benefits of motor drive, the selection of the most advantage-

ous control equipment is important. The principal functions of machine tool controllers are: (1) To start and stop the motor; (2) to reverse the direction of rotation; (3) to change the speed of the motor; (4) to provide a dynamic brake for stopping; (5) to provide a drift point; (6) to protect the motor and control; and (7) to protect the operator.

Manual Control

For machine tools requiring simple starting and stopping, an enclosed faceplate starter is the cheapest installation. When the duty is infrequent, this may suffice. The drum controller is better adapted for manual control when the service is at all severe. Drum controllers offer a greater range in controllability, and are commonly arranged for reversing service. If desired, speed control may be had, both by armature and field resistance methods.

If there is any possibility that the starting resistance may be employed for obtaining speed control, either intentionally or inadvertently, series resistors should be designed for regulating duty. The use of "starting duty" resistors in connection with drum controllers for machine tools is a doubtful practice. Drum controllers for machine tools may be and frequently are equipped with a dynamic braking provision to afford a quick stop. On such controls a drift point is also provided in case it is desired to remove the driving power without braking. Drum controllers include no protective features. Either a separate protective panel or a circuit breaker is a necessary adjunct to provide overload and undervoltage protection.

Magnetic Control

Magnetic control offers many attractive features for machine tool application. This type of control affords even greater flexibility of function than the drum controller. It includes protective features. Its location can be remote from the machine, which is often an advantageous arrangement. The control station comprises merely a few push-buttons or a compact and easily operated master controller. It requires a minimum of thought and attention on the part of the operator. Magnetic controls are particularly desirable where frequent starting, stopping, reversing, or manipulation is involved.

For the sake of uniformity, it will usually be found good practice to provide all direct-current motors, except perhaps the very smallest, with magnetic control. Push-button control stations may be used for the simpler controls, while master switches are preferable when greater manipulation is required. Simplicity and ruggedness are cardinal features. The panel should be totally enclosed for protection against dirt and tampering. The operating master or push-buttons should, of course, be located at the machine and where most accessible to the operator. Convenience in the location of control stations is a small matter but an important one. It may be desirable to be able to control a machine from more than one point. Duplicate stations, pendant switches, or mechanical extension devices are sometimes used to this end.

Some control equipments have been simplified and reduced in size to make them more suitable for convenient mounting on the frame or incorporation

in the pedestal or housing of machine tools. As has been stated previously, making the control and motor an integral part of the machine has advantages of built-in wiring between the motor and control, compactness, testing as a unit by the machine tool manufacturer, and requiring a minimum amount of wiring upon installation.

When magnetic control is applied to adjustable-speed motors, it will generally be found more convenient to install a separate field rheostat at the machine. This rheostat should be enclosed and protected as well as possible. In some cases, on repetition work, it may be desirable to locate the field rheostat at the panel, where it may be set for predetermined speed operation and possibly locked at that point.

In selecting an adjustable-speed motor, the fact should be considered that the speed range is determined by the rheostat resistance. It is not always necessary to utilize the full range of the motor rating. For instance, a motor rated 400/1600 revolutions per minute may be operated at from 400 to say 1300 revolutions per minute if the resistance is properly specified for that range. Care should be taken to avoid excessive or unsafe speeds by using too large a speed range. If the rheostat has too much resistance, the excess portion should be shunted out.

When adjustable-speed motors are used in conjunction with magnetic controllers, some form of field strengthening relay will usually be desirable at starting. Particularly if dynamic braking is provided, it may be necessary to prevent too rapid field strengthening when reducing the speed or when stopping.

In many cases, particularly where adjustable-speed motors are used with field resistors of necessarily fine wire, it is desirable to protect the motor and machine against overspeed in case of an "open" in the field circuit. This can be done by means of a field failure relay.

Alternating-current Drives

For starting squirrel-cage induction motors, manual auto-starters are frequently employed. Automatic starters are gaining in popularity. These may be of the across-the-line, the auto-transformer, the primary resistance, or the primary impedance type. Drum reverse switches are available for use with such starters, if desired. The starting torque of most machine tools is low, except flywheel type drives, which require high-torque squirrel-cage or wound-rotor motors. Wound-rotor motors may be provided with either drum or magnetic control, the latter being necessary for such drives as reversing planers and tapping machines. When there is a considerable number of large squirrel-cage motors installed in one shop, the use of one or two sets of transformers with partial voltage taps is suggested for consideration in conjunction with multi-voltage distribution and double-throw oil switches or contactors for starting.

The full possibilities of electric control are often overlooked. Mechanical means are sometimes employed at greater expense, when electrical control may accomplish the desired results in a better and cheaper manner. Control can be made to give

quick start, stop and reverse, smooth acceleration and slow down, fine speed adjustment and overload protection both to motor and driven machine. It may make possible the elimination of clutches, slip gears, speed reductions and shifts, and other mechanisms.

Having discussed, in a general way, the considerations involving the use of electric drive for machine tools, articles in coming numbers of MACHINERY will consider briefly various types of machines and their specific characteristics and requirements.

* * *

SAFETY DON'TS IN THE SHOP

By A. EYLES

The writer read with interest the "Safety Don'ts in the Shop" on page 470 in February MACHINERY, and would like to add a few as a result of his own experience and observations in a large engineering plant.

Don't start a machine without knowing that everything is ready.

Don't remove safety guards while the machine is running.

Don't neglect to replace safety guards after removing them for any purpose.

Don't depend upon others for your safety, but be careful yourself. Vigilance and watchfulness of each one promotes safety.

Don't use a drill unless it is running true.

Don't fail to keep all obstructions away from your machine. If tripped, you may put out your hands in attempting to save yourself, with the result that your hands may come in contact with moving parts and be injured.

Don't start drilling a piece of work until you are sure it is securely held.

Don't neglect the practical application of the Golden Rule as applied to safety.

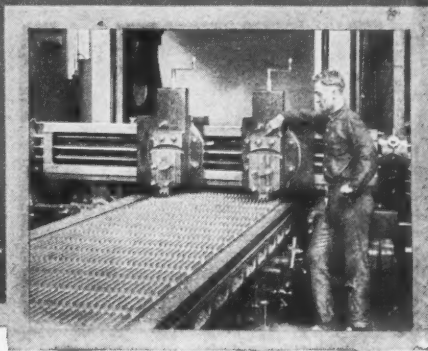
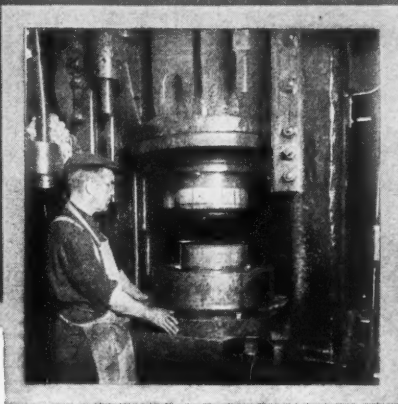
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ALLOY STEEL FOR LOCOMOTIVES

Alloy steel is likely to be used to an increasing extent in modern locomotives. The greater capacity of present engines makes the use of a steel of great strength necessary. Alloy steels have already been adopted on many roads for such parts as main and side rods, crankpins, axles, and piston-rods. The results, however, have not been uniform. Some roads have found the use of the new material very successful, but others have met with discouraging experiences and have abandoned the new material and returned to straight carbon steel.

In view of the successful use of alloy steels in automobiles, it is almost certain that the failure in locomotive practice has been due either to the selection of the wrong kind of steel for the purpose, or to improper heat-treatment of the steel. Alloy steels require very careful handling and treatment. Unless properly heat-treated according to exact formulas, these steels may not prove superior to ordinary carbon steels. Adequate heat-treating facilities and proper training of the men performing the heat-treatment must go hand in hand with the adoption of these high-grade materials.

Letters on Practical Subjects



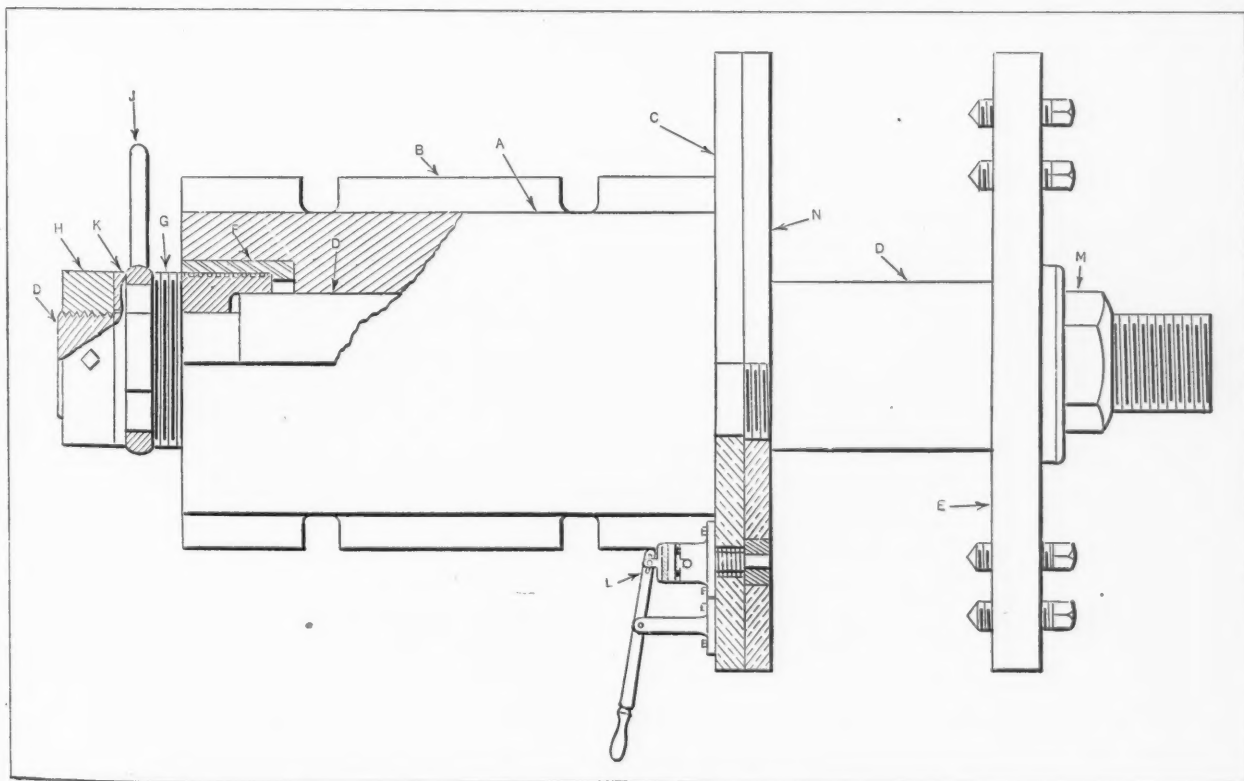
DRIVING-BOX PLANING FIXTURE

The illustration shows a useful fixture for holding locomotive driving-boxes while paralleling the shoe and wedge faces. This fixture can be used on shapers or planers, and will be found a time- and labor-saver. It consists of a body *A*, base-plate *B*, and faceplate collar *C*, cast integral, and a steel shaft *D* which serves as an arbor and fits into the body of the fixture. A large faceplate *E* is attached to the outer end of this shaft by set-screws placed to accommodate the various size boxes. Flange *N* is threaded tight against a shoulder on shaft *D*.

The back end of the body of the fixture is bored for the press-fitted steel bushing *F*. This bushing is square-threaded on the inside to receive the threaded plug *G* which turns freely in the bushing. Plug *G* has a hexagon-shaped end. The extreme left-hand end of shaft *D* is threaded to receive

collar *H*. The wrench *J* is placed on the plug before the collar *H* is secured in position. Space ring *K* acts as a thrust washer, and prevents wear on nut *H*. Lever *L* is used to index the driving-box, the index-pin being inserted in bushings in disk *N* which are exactly 180 degrees apart.

To operate the fixture, place a driving-box on the arbor *D*, and then tighten nut *M* and the set-screws. See that the indexing device *L* is in position and that plug *G* is tight. Machine one side of the driving-box; then withdraw the indexing pin. Next, pull down on wrench *J*. This will force the arbor outward so it will be free to rotate. Turn the box 180 degrees and drop the indexing pin into the bushing in flange *N*. Then pull up on wrench *J*. This will draw the arbor inward and clamp the flange *N* against the faceplate *C*. By using this fixture, it is only necessary to set the box up once to machine the two parallel sides.



Fixture for Holding Locomotive Driving-boxes while Paralleling the Shoe and Wedge Faces

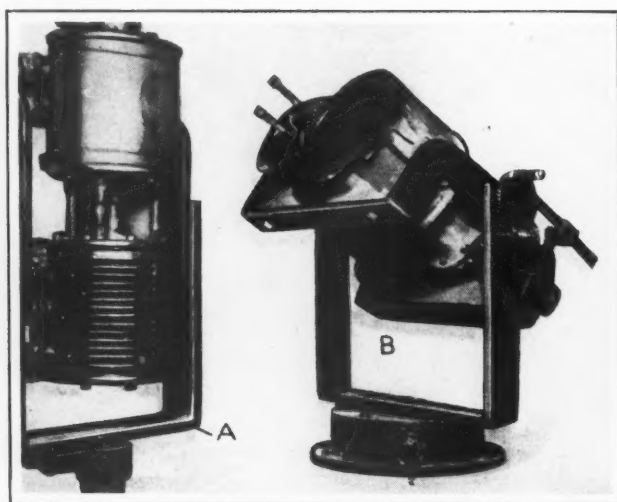


Fig. 1. Repair Racks with Locomotive Air Pumps in Place

A swivel base may be applied to the fixture which will make it possible to plane both flanges of the driving-boxes for the rocking clearance. This fixture will be found very useful in any shop where driving-boxes are handled.

Portsmouth, Ohio

J. H. HAHN

REPAIR RACKS FOR LOCOMOTIVE AIR PUMPS

The pump or compressor repair racks shown in the accompanying illustrations are designed to hold the work in the most convenient positions for overhauling and making repairs. At A, Fig. 1, is shown a rack adjusted to hold the pump in a vertical position, where the workman can easily remove any of the parts. At A, Fig. 2, is shown an empty rack, and at B a rack with a cylinder in place, tilted at an angle which facilitates placing the cylinder packing rings in their proper positions. The rack can also be adjusted to hold the cylinder in a horizontal position for re boring and grinding the cylinder without disturbing the setting.

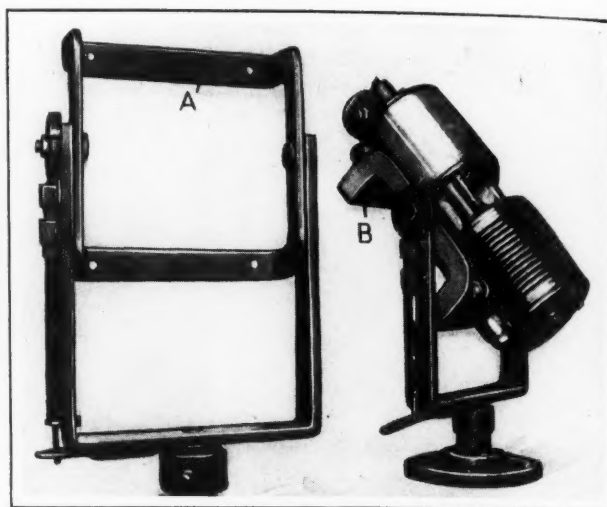


Fig. 2. Unloaded and Loaded Racks

The pump bracket shown at B, Fig. 1, and in Fig. 3 has a supporting frame, as shown at E. The tilting of the rack is accomplished by means of a hand-crank, which operates a worm and bevel gear drive. The steel base G is bolted to a concrete foundation. Upon this base rests the roller bearing support H. The block I swivels on the roller bearing, and can be locked in eight different positions by the latch J, which can be made to engage one of the indexing slots.

Chattanooga, Tenn.

H. H. HENSON

KEEPING GRINDING WHEELS IN BALANCE

Chatter was apparently the cause of trouble experienced in obtaining the desired finish on certain ground surfaces. On examining the grinding machine, however, there seemed to be nothing out of adjustment. It was finally suggested that the grinding wheel might be out of balance. As no suitable balancing equipment was available, the grinding wheel was sent to a neighboring shop, where it was tested and found to be out of balance.

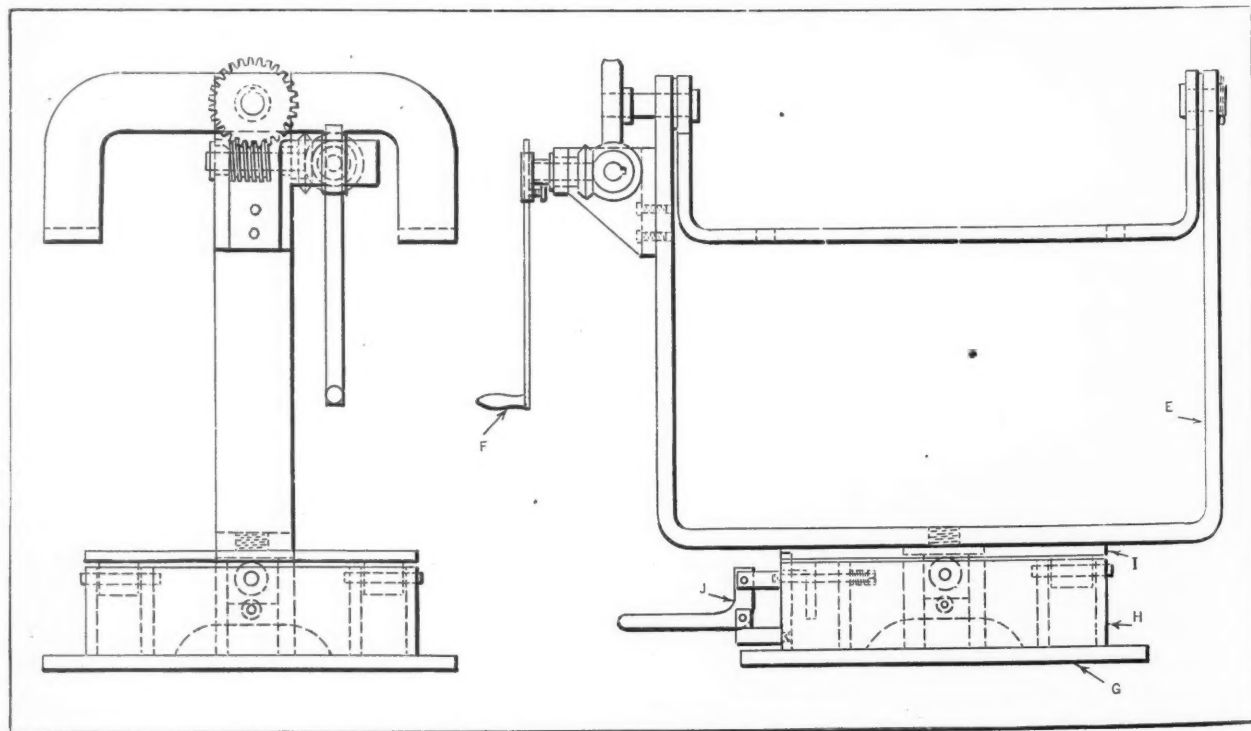


Fig. 3. Assembly Views of Racks Shown in Figs. 1 and 2

After being properly balanced, the wheel was returned to the user. An excellent ground surface was then obtained, proving that the chatter marks were caused by the unbalanced condition.

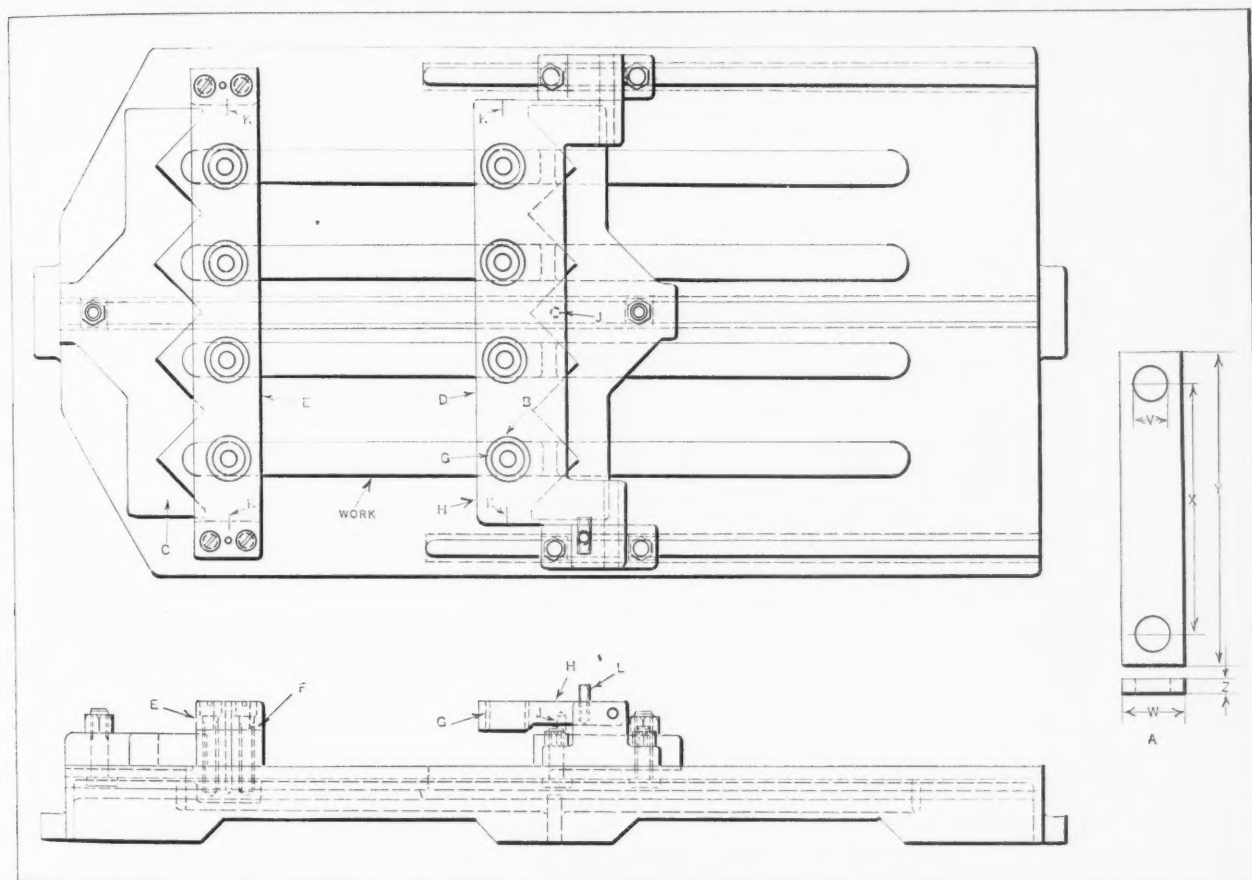
As there were several grinding machines in the shop, it was decided to obtain a pair of balancing rails from the makers of the grinding wheels and also secure all the information available on their use. The balancing rails were placed in the tool-room and one man given the job of checking the balance of each wheel when it was returned to its storage rack or whenever it gave trouble.

It is practically impossible to produce wheels that are absolutely uniform in density. This variation in density results in uneven wear, so that practically all grinding wheels become unbalanced

UNIVERSAL JIG FOR DRILLING PADS

The universal drill jig shown in the accompanying illustration is employed in drilling links or pads like the one shown at A. These pads are used as risers for motors and pumps or similar equipment. The dimensions indicated by the letters X, Y, and Z are varied to suit conditions. The jig can be adjusted to handle all the sizes required. It has a capacity for drilling holes up to 1 inch in diameter and will accommodate pads up to 1 inch thick, 3 inches wide, and 28 inches long. Thin pads may be stacked one upon the other until the maximum height of 1 inch is reached. The drill is guided by slip bushings made up in sizes as required.

Each of the locating blocks C and D have four V-shaped notches for locating four pads in position



Jig for Drilling Pads or Links of Various Lengths and Widths

after a short period of use. Many of the difficulties previously encountered when grinding were eliminated by the adoption of the balancing practice. Also, the wheels need truing less frequently than formerly, which results in lengthening their life and the life of the truing diamond.

The proper balancing of the grinding wheels in this shop, as in many others, had been neglected as unimportant, but the results obtained proved balancing to be an essential factor in economical production. Formerly, when chatter occurred, it had been remedied by tightening up the spindle bearings; this usually remedied the trouble temporarily, but the bearings often ran hot after a short time and their life was accordingly shortened. Placing all grinding wheels under the care of one man has proved profitable, the same as placing one man in charge of all driving belts.

Brentford, England

W. E. WARNER

for drilling. The blocks D and C may be adjusted on the base to provide for drilling pads of any desired length up to 28 inches. Clamping bolts placed in T-slots, as shown in the illustration, serve to clamp the locating blocks in place. It will be noted that the corners of the pads are located by the contact they make with the V-notches in the locating blocks.

The bushing plate E is secured in a fixed position on the base. The under side of plate E is beveled at F to facilitate loading and unloading the jig. Liner bushings like the one shown at G, which receive the slip bushings, are inserted in both the fixed plate E and the hinged plate H. The hinged plate is supported in a level position by the pin J. Four center lines K are scribed at the ends of the bushing plates to facilitate measuring the center distance when setting up the jig. When the jig is in operation, the hinged plate H is thrown back

and the work put in place. The hinged leaf is then swung back and clamped in place by the quarter-turn locking screw *L*.

Bridgeport, Conn.

J. E. FENNO

FORMING TOOL FOR GRINDING WHEEL

It was required to grind a series of grooves of various radii in a pair of steel rolls. The rolls were for an experimental job, and therefore only an inexpensive grinding wheel truing arrangement was warranted, yet it was necessary to dress the wheel as accurately as possible. The tool shown in the accompanying illustration was found to give excellent results.

Plate *A*, with one edge forming the arc of a circle of convenient radius, is fastened to the channel-shaped piece *B*, so that the diamond dresser *C*, held in the block *D*, is on the center line of the abrasive wheel. Projecting from the back of block *D* are two pins *E*, equally distant from the center line of the diamond dresser *C*.

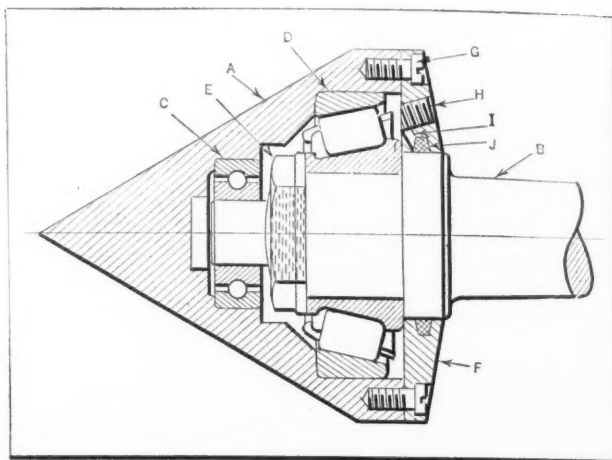
In use, the block *D* in which the diamond dresser is fastened is placed on plate *A* with the pins *E* in contact with the curved edge of the plate. Block *D* is then moved by hand across the plate, keeping the pins in contact with the curved edge. The diamond point of the dresser is thus caused to describe an arc, the radius of which is varied by setting the dresser in or out of the block. Channel *B* is mounted on a cross-slide, so that the dresser can be fed against the grinding wheel as desired.

Philadelphia, Pa.

R. H. KASPER

BALL AND ROLLER BEARING LATHE CENTER

In the plant where the writer is employed, it is necessary to use a large live center on certain



Lathe Center for High-speed Work

lathe jobs. To meet the requirements of this severe service, the writer recently designed a center that is giving very satisfactory results. This new design, which is shown in the accompanying illustration, permits higher speeds to be used without burning the center, as often happens with the fixed type.

The conical point *A* is hardened and ground steel, as is also the shank *B*. At *C* is a Gurney ball bearing which supports the front end of the conical center. A Timken precision roller bearing *D* takes the thrust imposed on the center. The ground face of nut *E* clamps the Timken bearing securely to the ground face of the shank. The plate *F*, secured to the rear surface of the conical center piece, is held in place by four fillister-head screws, one of which is shown at *G*. The bearings are oiled through the tapped hole *H*. A 1/8-inch hole *I* serves to conduct the oil to the packing *J*.
Ludlow, Ky.

ROBERT H. LANG

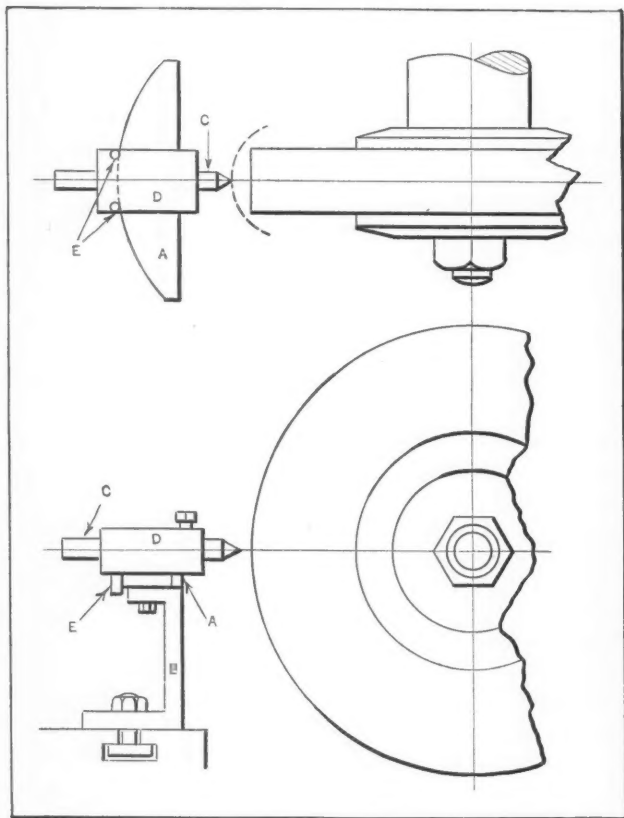
WORN SHAFT BUILT UP BY GAS TORCH

The shaft and bearing of the mangle gear drive of a printing press bed is shown in the accompanying illustration. The shaft *S* is driven through a universal joint (not shown). The pinion *P* drives the rack located under the press bed, engaging first the top and then the bottom of the rack. The shaft and gear are rolled from one position to the other by means of parts not shown in the illustration.

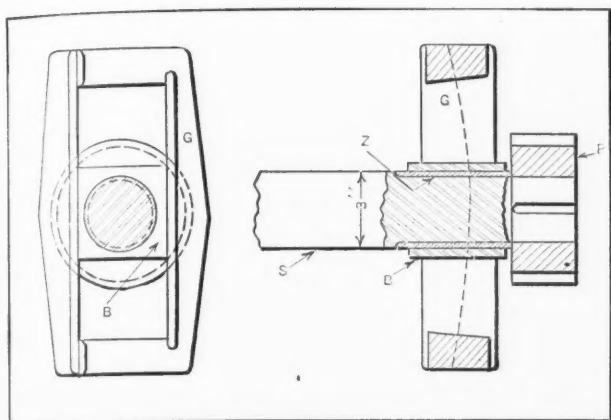
When the press is in operation, shaft *S* revolves continuously at a speed of 100 revolutions per minute, and has a vertical movement at each end of the bed travel. The block *B* is a close fit in the slot in part *G* which restricts the shaft to a vertical movement when the bed reaches each end of its travel. Block *B* is hardened and ground all over. The shaft is not hardened, but is of a grade of steel which the makers have used successfully for years.

The press had been in service but a short time—after rebuilding—when shaft *S* stuck in its steel bearing *B*. The shaft was taken out, the block pressed off, the pins removed, and the machine assembled again. It was thought that lack of lubrication caused the shaft to stick, but the same trouble soon developed again.

Inspection showed that the alignment of the shaft and bearing was correct and that ample lubrication was provided. The shaft was also round



Tool for Forming Radius on Grinding Wheel



Steel Mangle Gear Shaft Resized with Bronze Bearing Surface

and smooth, as was also the bearing in the steel block. A difference of about 0.005 inch in the diameter of the shaft and the hole in the bearing was noted, but this did not seem great enough to cause the trouble. The movement of the driven parts was also checked for undue friction.

In spite of these facts, the same trouble developed again. This time the shaft was turned down to a diameter of 2 7/8 inches for a length slightly greater than the length of the block bearing. The acetylene torch was then used to build up a layer Z of bronze to a size somewhat larger than the diameter of the hole in the bearing block. Next the bronze was turned down to a diameter that just permitted the shaft to be wrung into the steel block. The parts were then oiled and assembled. With no other change, the press has run very satisfactorily for months.

The bronze of the shaft against the steel of the bearing block undoubtedly provides a much better running bearing than steel to steel, and with the shaft more nearly fitting the bearing, there is a greater contact area, with a resulting reduction in the unit bearing pressure. Whether the better running quality of the bronze on steel or the more closely fitted bearing served to eliminate the trouble is not known, but the ultimate wear will doubtless reveal which factor was the most important. In any case, the repair is an interesting one, and its success suggests that the same methods might possibly be applied to advantage in new construction.

Middletown, N. Y.

DONALD A. HAMPSON

FINISH ALLOWANCE ON CASTINGS

An important item in the operation of machine shops is the amount of finish allowance to be left on castings. Great savings may be realized by watching this matter. According to present fairly general procedure, a design is created and drawings are made; before they are passed into the shop, they are carefully scanned with a view toward economy of production. Then the patternmaker comes on the scene. The patternmaker works according to a given set of rules and shrinkage scale, allowing 1/16, 1/8, or 1/4 inch where finish is required, mostly according to his own judgment and the size of the pattern to be made. We recently adopted a method of finish allowance control which is well worth the trouble of using it.

According to our method, if about twenty-five or more fairly heavy castings are to be made we order first only two castings to be made from the pattern. Then we give one each of these to two different men, with instructions to machine to drawing. After they have done this, we ask each of the men for their opinion as to where the finish may advantageously be reduced or increased. Besides this, we watch the work ourselves. Invariably, the recommendations of the two men coincide, and the pattern is changed correspondingly.

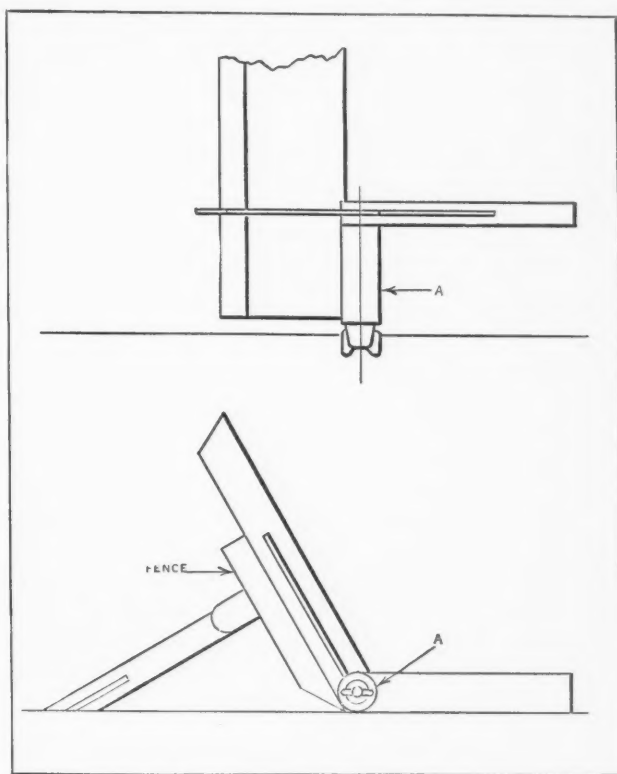
An example will make plain how this method worked out in one instance. Our requirements called for 24 castings to be made of a bronze worth 65 cents a pound. By this method of finish allowance control, we were able to save 2 1/4 pounds on each casting, and the reduced machining time amounted to 17 minutes each. The saving on the cost of 22 castings (two of the castings having been previously machined to determine the finish allowance, as explained) at 2 1/4 pounds each, amounted to \$32.17. The time saved on 22 pieces, at approximately 17 minutes each, was 374 minutes. At a saving of two cents a minute this amounted to \$7.48. Thus the total saving was \$39.65.

Baltimore, Md.

RAYMOND H. DAUTERICH

A BEVEL GAGE FOR PATTERNMAKERS

To gage the setting of woodworking machine fences at an angle other than a right angle, the bevel must be held in a plane exactly perpendicular to the fence; otherwise the fence angle and the bevel angle will not be the same. Patternmakers sometimes use a square in conjunction with the bevel to accomplish this, but this is unhandy, and where there is a gap between the bottom of the fence and the machine table, it cannot be done at all.



Setting Fence on Woodworking Machine

The bevel shown in the accompanying illustration was devised especially for use in setting fences on jointers, circular saws, disk grinders, and similar machines. Its form is similar to a carpenter's bevel, particular attention being given to producing a nice fit of the clamping screw in the blade slot. The base of the bevel is made into a square by having a cylindrical projection A, of the same diameter as the width of the base of the bevel, fastened to the locking nut end in such a way that the bottom of the base of the bevel is tangent to the circumference of the cylinder.

In stave work—the common job of lagging cylindrical patterns or core-boxes—with an accurately set fence, the segment strips can be very quickly ripped out and used without any subsequent hand fitting.

Willimantic, Conn. HERBERT A. FREEMAN

FRICTION WRENCH FOR STUFFING-BOX NUTS

In assembling a stuffing-box nut X, Fig. 1, on the top of a water meter, it was found that when the operator used an ordinary socket wrench for tightening this nut, he generally jammed it down so tight on the packing Y that the shaft Z, which passes through the gland and the nut, was prevented from turning freely. If warned about this, the operator would become over-cautious, with the result that the nut would be left too loose and the gland would leak.

Since these meters were made in large quantities, it became necessary to design and build a friction wrench. This wrench is shown in Fig. 2. It was made so as to turn the nut until the resistance encountered would cause slippage of the wrench at a predetermined pressure, thus seating the nut at a pressure that would allow free turning of shaft Z without any water leakage.

The fixture, which has the form of a socket wrench, consists essentially of the casing A, the ring B, the wrench sleeve C, and the friction rings L, M, and K. Rod E is driven through the shank of the casing A, and serves as the wrench handle. The ring B fits in a recess in the bottom of the casing, and is connected to the casing by six equally spaced screws F, threaded into the nuts G, which are sunk into the bottom of the ring. These screws pass through six gum rubber bushings H, which are set into the top of the casing A and project above the casing 1/8 inch. Held on top of these bushings by the screws F is a pressure equalizing plate J. The function of these rubber bushings is to provide pressure, at all times, through the nuts G on the ring B, no matter what may be the degree of tightness of the nuts.

The wrench sleeve C, which fits a recess in the top of ring B, has pinned to it a fiber ring K, which makes frictional contact with ring B. A fiber ring L, sunk in and pinned to the top of wrench sleeve C, makes frictional contact with a fiber ring M, which is pinned in a recess in casing A. In the bottom of wrench sleeve C, is driven and pinned the wrench bushing R, which contains a hexagon hole that fits over the nut X, Fig. 1, to be tightened.

The action of the fixture is as follows: Nut X is given a few turns by hand on the threaded gland of the meter. The meter is then passed along to

another operator, who drops the friction wrench over the nut, and turns the wrench by handle E. Turning casing A also turns the friction ring M which is pinned to it. This ring M, making frictional contact with the fiber ring L, causes it to turn, and being pinned to wrench sleeve C, carries the sleeve with it. An additional drive is transmitted from casing A through the six screws F to ring B, and frictionally to the fiber ring K. When the resistance encountered is greater than the frictional contact of the rings, slippage occurs. The

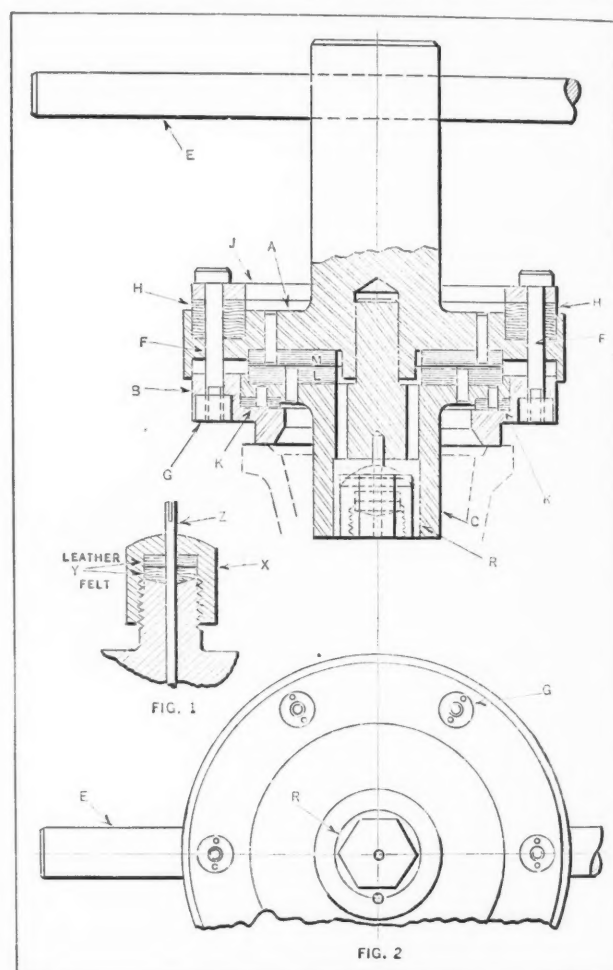


Fig. 1. Water Meter Gland. Fig. 2. Cross-section and End Views of Friction Wrench Used to Adjust the Water Meter Gland

point at which this happens is determined by experiment. The frictional resistance can be varied by turning the nuts G.

New York City

B. J. STERN

* * *

EXPORTS TO SOVIET UNION

According to information issued by the Amtorg Trading Corporation, during the six months ending March 31, goods to a value of over \$65,000,000 were purchased in the United States for shipment to the Soviet Union. Sales of Soviet products in the United States for the same period amounted to slightly over \$8,000,000, to which should be added sales of furs to a value of over \$6,000,000. Of the purchases in the United States, industrial equipment amounted to \$6,500,000; agricultural machinery, \$4,000,000; and automotive equipment, \$1,250,000. The largest group of purchases made here was raw materials—especially cotton, metals, and rubber.

New Sykes Gear-cutting Machine

THE general principles involved in the Sykes process of cutting gears, especially as applied to the generating of double helical or herringbone gears of the continuous-tooth type, were described in an article, "Generating Herringbone Gears," in November, 1925, *MACHINERY*. This article also dealt with the important features of the Sykes generators that had been built up to that time, and illustrated and described the type of cutters employed in these machines. Since that time considerable progress has been made both in the application of this type of gear in many different industries and in the development of new machines with improved features for producing these gears.

The range of application of double helical gears may be best understood by noting the fact that gears of this type have been produced on Sykes machines all the way from 1 inch in diameter, 5/8-inch width of face, and 12 diametral pitch, up to gears 170 inches in diameter, 42-inch width of face, and 1 diametral pitch. A machine is now being built that will have a capacity for cutting gears up to 20 feet in diameter, 54-inch width of face, and 5-inch circular pitch.

Where Double Helical Gears are Used

As to the uses to which these gears are now being applied, it may be mentioned that several of the leading makers of reducing gear units have brought out complete series of reduction gears employing gears of this type in the transmissions. Many machine tool builders are also using these gears in planers, radial drills, boring mills, engine lathes, shapers, and special machine tools. They are also employed for power presses, rolling mills, coal pulverizers, and hoisting equipment.

In the smaller sizes, gears of this type have been found particularly suitable for rotary pumps, and have been highly successful for pumps for ammonia gas for refrigerating machinery, which is recognized as a most exacting service for a pump of this type. Other important applications are in marine gasoline engines and airplane drives. Abroad, they have been applied to automobile drives as well.

The accompanying illustrations, Figs. 1, 2, and 5, show some recent applications. Fig. 1 shows the gear-box of an engine lathe; Fig. 2, an unusually large gear used in the Hardinge conical ball or pebble mill; and Fig. 5, a set of gears for a piercing mill, these gears being 6 feet in diameter, 42-inch width of face, and 1 diametral pitch.

Improved Sykes Gear Generator

The Farrel-Birmingham Co., Inc., Buffalo, N. Y., builder of the Sykes gear generating machines, has recently brought out a new improved machine known as the No. 4A, which has a capacity for cutting gears from 1 to 49 inches outside diameter, from 12 to 1 1/2 diametral pitch, with a maximum face width for double helical gears of 18 inches, and for spur gears, of 10 inches. This machine, the general principles of the design of which will be described in the following paragraphs, is designed along the same lines as the machine illustrated and briefly described in February, 1927, *MACHINERY*, page 474, but embodies a number of additional improvements.

Fig. 3 shows the appearance of the machine. Following the general principle of the Sykes machines, the cutters are mounted with their axes horizontal, the work axis being also horizontal. This feature has been adopted because of the many advantages that the builders have found to be inherent in this method of design.

For the principles of design involved, the reader is referred to the complete description that appeared in November, 1925, *MACHINERY*; in the following, only the general design is outlined, and the new and improved features referred to in detail.

To illustrate in a simple manner the principles of the mechanism employed in these gear generating machines, the diagrammatical illustration Fig. 4 is shown. As was explained in the article referred to in November, 1925, *MACHINERY*, the generating motion required, with the pinion cutter used in the Sykes system, is rotary, and therefore simply obtained. It is only necessary to revolve the cutter and work spindles in the same relation to each other as if teeth were already cut in the gear blank.

Fig. 4 shows that there is only one set of change-gears on the machine and that these regulate the speed of the worms which drive the indexing worm-wheels through which the cutters and the gear blank are controlled. It will be seen that the motion imparted both to the cutters and the work-spindle is continuously in one direction and that there is no intermittent indexing.

Main Drive and Crank Mechanism

On the machine designated as 2A, briefly described in February, 1927, *MACHINERY*, the main drive for the crank operating the reciprocating car-

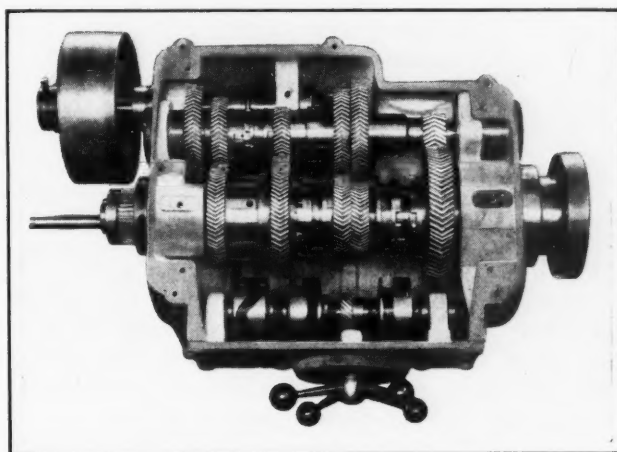


Fig. 1. An Engine Lathe Gear-box in which Double Helical Gears are Used

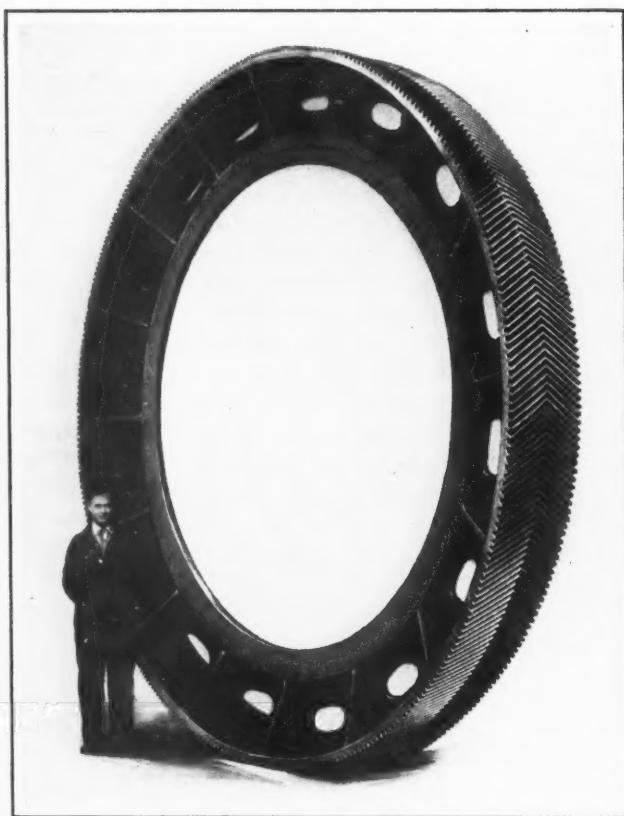


Fig. 2. An Unusually Large Gear Used in a Hardinge Conical Ball or Pebble Mill

riage is through a belt to a four-speed gear-box equipped with herringbone gears in constant mesh. This machine is designed for belt drive either from a countershaft or from a motor. The new 4A machine here described is direct-connected to the motor through the gear-box. The speeds are quickly selected by operating the lever at the side of the gear-box, the driving connection to the gears being made through gear-tooth clutches.

The crank disk has three T-slots cut in it. One of these—of large dimensions—passes across the center, and the other two—of smaller size—are parallel to it, one on each side. In the central slot, the base of the crankpin is accurately fitted, and in this part of the crankpin, the thread that forms the adjustment nut is cut. Hence, the adjusting screw passes through the central slot and through the nut in the crankpin and is supported at each end in bronze bearings inserted in the crank disk. Thrust collars are so arranged in connection with this design that the screw can never be subjected to stresses other than tensional. The crankpin has a flange forged solid on it and fitted to bear on the face of the crank disk, to which it may be securely clamped by means of bolts fitted in the two T-slots that are cut parallel to the central slot.

The Reciprocating Carriage and the Cutter Brackets

The reciprocating carriage is made of deep box section to insure rigidity under the heaviest cuts. The adjustment is made by two wedges, fitted at each end of the main bed.

The cutter brackets are adjustably mounted on the reciprocating carriage. A projection is provided on each cutter bracket which acts as a register of its location on the carriage. Adjustment is obtained by means of two screws passing through the register slot in the reciprocating carriage, and provision is made for securing the brackets in any desired position by means of a clamping device operated from the end of the carriage. On the 2A machine one worm-wheel was provided for each cutter bracket, but on the 4A machine each cutter bracket is held by two worm-wheel nuts and double worms—right- and left-hand—which are so arranged that the tension of each screw is equalized.

Design and Arrangement of the Work Saddle

The work saddle—of box section—is designed to withstand the heavy stresses caused by deep cuts at high speed. The guide for keeping it in alignment has been made especially long, and is placed near the center, approximately in line with the cutters. This arrangement has the advantage that, when heavy cuts are taken, the work deflects away from the cutters, thereby preventing damage to the cutting edges and permitting heavy cuts to be taken without danger of breakage.

The bearing of the work saddle on the bed of the machine has been extended forward, on the 4A size, such a distance that the support of the saddle will always extend beyond the cutting point of the cutters, even when the largest gears are being cut on the machine. The main work-spindle is exceptionally large to prevent any appreciable torsional deflection, and is provided with a large bored hole for accommodating pinions integral with their shafts. Lock-nuts are provided for taking up end play.

The Feed Mechanism and Change-gears

The generating feed mechanism is driven by the crankshaft through a four-speed change-gear box. Between the gear-box and the crankshaft a friction coupling is placed so that the feed may be disengaged automatically in case of accident to any part of the mechanism.

The change-gears are mounted in a position convenient to the operator. No calculations are required for determining the correct change-gears to use, because the driving change-gear may have the

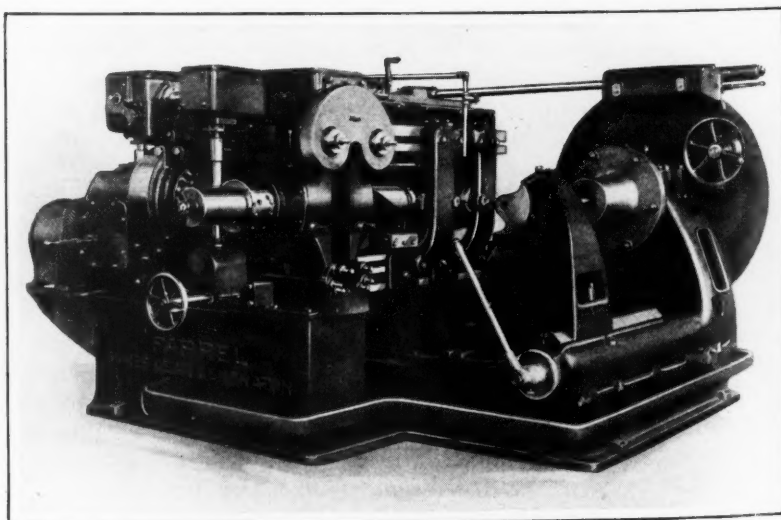


Fig. 3. Sykes Gear Generator for Cutting Gears from 1 to 49 Inches Outside Diameter

same number of teeth as there are in the cutter, and the driven gear, the same number of teeth as in the gear to be cut. Any gears having the same ratio can, of course, be used.

The Indexing Mechanism

The accuracy of any machine of this type depends largely upon the accuracy of the indexing mechanism, and for this reason, both the main indexing worm-wheel and the cutter indexing gears are carefully cut with hobs specially made for the purpose. The teeth are made unusually long in order to maintain accuracy, and the worms are provided with double ball thrust bearings and provision for eliminating backlash. The worm of the main indexing worm-gear can be quickly disengaged, to permit the main spindle to be revolved rapidly. This quick revolving motion on the 2A machine is made by means of a star handle on the index-wheel, while on the larger 4A machine, a handwheel and reduction gearing are provided for this purpose.

The Depth-feed Mechanism

The mechanism for feeding the cutters into the gear to be cut is fully automatic on the 2A machine, and by proper setting, the machine will cut to full depth in one or more cuts automatically. The depth of each of the several cuts may be predetermined by the operator by setting dogs on a ratchet wheel. On the 4A machine, the feeding to depth is entirely by hand. Most of the work cut in this machine is large, the time for the cuts is longer, and the advantage of an automatic feed would not be so great as in the case of the smaller machine. Further, on the larger machine, the saddle is locked to the bed when the cut is taken, and to lock and unlock the saddle automatically would necessitate an additional automatic mechanism.

The hand adjustment for depth feed is provided at the end of the machine by a lever so located that the operator can clearly see the cutters while making the feed adjustment. An independent power rapid traverse movement to the saddle is also provided for feeding in quickly, when setting up the machine. This movement is actuated by a push-button control and is in operation only when the

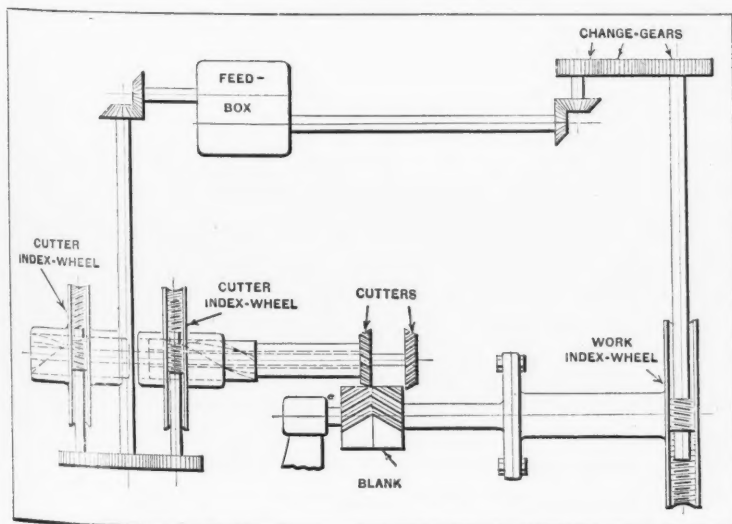


Fig. 4. Diagrammatical Illustration Showing the Principle of the Mechanism Employed in Sykes Gear Generating Machines

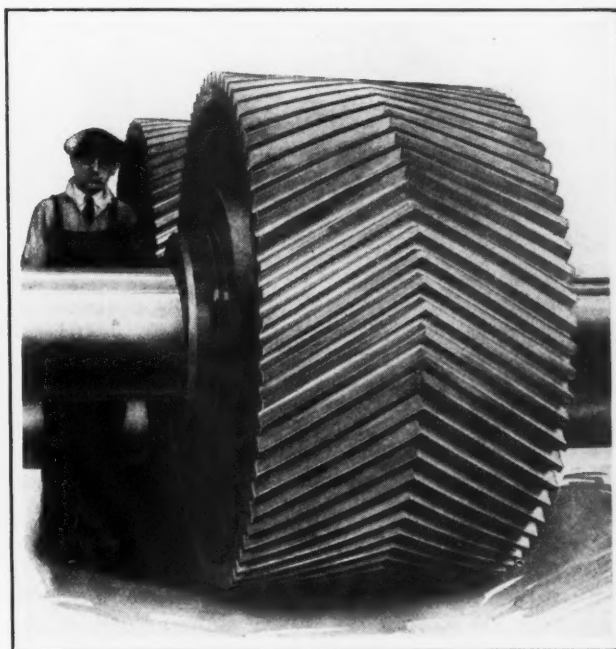


Fig. 5. A Set of Double Helical Gears for a Tube Piercing Mill

button is pressed. The independent depth feed movement is not used for feeding the cut.

Rim Support for Large Gears

Because of the large work cut on the 4A machine, rim supports in the form of rollers mounted on brackets to take the thrust of the cut are provided. These rim supports are adjustable by means of a handwheel at the end of the machine. The adjustment is through a right- and left-hand screw which is free to float, so that both supports can be brought up rapidly to any position required. When small work is cut on the machine and the rim supports are not considered necessary, they can be easily removed. For large work, however, this feature is one of considerable importance.

Lubrication of the Machine and Provision for Coolant

All gears in the gear-boxes run in oil baths, and all working surfaces are automatically lubricated. The back of the vertical section of the bed contains the pump for the cutting lubricant. The coolant is returned to the pump by troughs cast around the lower part of the bed. The cutting lubricant is contained in the base of the main bed, divided into two sections by a low partition, which prevents any dirt and chips that may be in the lubricant from being returned to the pump. The pump is of the rotary geared type, operated by a chain from the main drive box.

A cutting fluid which has some lubricating properties is recommended. Some coolants have a tendency to cause rust on the machine or to have deposits on the working parts. A coolant that has some lubricating properties will benefit the machine rather than otherwise.

This machine will cut spur gears, ordinary helical gears, and double helical gears. By using special cutters and cams,

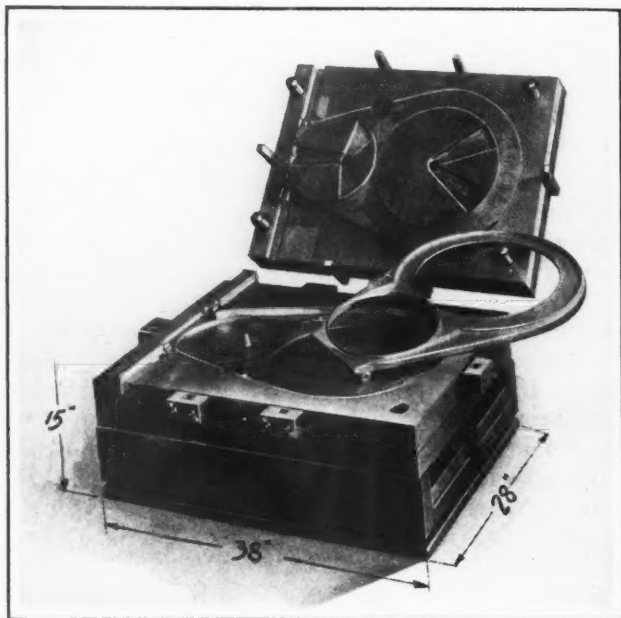
spline shafts may be cut. Cluster gears can also be produced by the use of two cutters of different sizes, which enable the two gears in the cluster to be cut simultaneously.

It is claimed that this new machine is capable of producing continuous-tooth herringbone gears of certain sizes in less time, and all sizes within the range of the machine in no greater time, than is taken by gear-cutting machines built especially for producing spur gears. As an example, it used to take approximately 11 hours to produce a gear with 90 teeth, 2 1/2 diametral pitch, 10-inch face, made of cast steel of approximately 22 scleroscope hardness, but these gears are now produced in 6 to 6 1/2 hours, actual cutting time.

* * *

A LARGE DIE-CASTING DIE

The accompanying illustration shows a die-casting die for making an aluminum casting of large dimensions. While this is not the heaviest aluminum casting made, it is believed to be one of the largest in over-all length and width. The



A Die for Making a Die-casting 32 Inches Long by 21 Inches Wide

length of the casting is 32 inches; the greatest width, 21 inches; and the weight, 4 1/2 pounds. The weight of the die is 4100 pounds. The die was made by the P & R Tool Co., Inc., 100 Lamartine St., Worcester, Mass.

* * *

FOREMEN'S MEETING IN CANTON

The fifth annual convention of the National Association of Foremen was held in Canton, Ohio, Friday and Saturday, May 25 and 26. F. A. Seiberling, president of the Seiberling Rubber Co. and founder of the Goodyear Tire & Rubber Co., spoke on "The Requisites of the Foremen of Tomorrow." W. Chatten Wetherill, of the University of Pennsylvania, spoke on "Industrial Waste." J. C. Wright, director of the Federal Board for Vocational Education, spoke on "Foremen Conferences," and Robert H. Spahr of the United States Chamber of Commerce, on "The Foreman as an Executive."

LINCOLN ARC-WELDING PRIZES AWARDED

One of the outstanding events at the spring meeting of the American Society of Mechanical Engineers in Pittsburgh, Pa., May 14 to 17, was the awarding of the prizes offered by the Lincoln Electric Co., Cleveland, Ohio, through the society, for the best papers on electric arc welding, that would contribute valuable information and ideas on the art of arc welding. The first prize was \$10,000; the second, \$5000; and the third, \$2500. The details and conditions of the contest have been published in previous numbers of MACHINERY.

The first prize, \$10,000, was awarded to James W. Owens, director of welding at the Newport News Shipbuilding and Dry Dock Co., Newport News, Va., for a paper entitled: "Arc-Welding—Its Fundamentals and Economics." This was a most comprehensive treatise on arc-welded design and shop practice and an analysis of its industrial applications and possibilities. The second prize, \$5000, was awarded to Professor Henry Dustin of the Faculty of Applied Science, University of Brussels, Belgium, for a paper entitled: "Fundamental Principles of Arc Welding." The third prize, \$2500, was awarded to Commander H. E. Rossell of the Mathematics Department, U. S. Naval Academy, Annapolis, Md., for a paper entitled: "Electric Welding of Ships."

The prizes were distributed by Alex Dow, president of the American Society of Mechanical Engineers. Mr. Lincoln, of the Lincoln Electric Co., in a brief address, pointed out the possibilities of electric welding. In all, seventy-seven contestants had entered papers to be passed upon by the judges in the awarding of the prizes.

* * *

STANDARDIZING HACKSAW BLADES

In accordance with the unanimous action of a general conference of representative producers, distributors, and users of hacksaw blades, held in Washington April 12, the Department of Commerce is submitting for the approval of the industry a simplified list of hacksaw sizes, which eliminates many of the sizes previously made. Those interested may obtain a list of the proposed sizes by addressing Commercial Standards, Room 316, Commerce Building, Washington, D. C. A committee has also been formed to cooperate with the Department of Commerce in the establishment and proper functioning of the recommendations for simplification that have been made.

* * *

SCHOOP METAL SPRAYING PROCESS

Our attention has been called to the fact that no mention was made in the article, "Coating by Molten-metal Spraying," which appeared in November, 1927, MACHINERY, of the name of the inventor and original developer of this process. Reference was made, however, to the article that appeared in September, 1914, MACHINERY, "The Schoop Metal-spraying Process," which was the first article published in a mechanical journal in America on the process developed by M. U. Schoop of Zurich, Switzerland, who after many experiments produced a process that made it possible to coat surfaces with atomized metal.

Mechanical Engineers' Meeting in Pittsburgh

THE national spring meeting of the American Society of Mechanical Engineers was held in Pittsburgh, Pa., May 14 to 17, with headquarters at the William Penn Hotel. It was one of the most active spring meetings that the society has ever held. The program was crowded with the reading and discussion of papers covering almost every field of mechanical engineering and with the meetings of committees on standardization, research, technical and trade education, and professional engineering work. Those interested in a complete list of the papers read before the meeting are advised to communicate with the secretary of the society at its headquarters, 29 W. 39th St., New York City. In the following only a brief review of the main sessions and of the papers of especial importance in the machine shop field will be given.

Special sessions were held pertaining to the following fields of mechanical engineering: Machine shop practice, applied mechanics, materials handling, power stations, properties of alloys, engineering education, railroads, hydraulic engineering, seamless tubing manufacture, heat and fuels, glass manufacture, and management.

Ball-bearing Machine Tool Spindles

In a paper by Thomas Barish, assistant chief engineer of the Gurney Division, Marlin-Rockwell Corporation, Jamestown, N. Y., on "Ball-bearing Machine Tool Spindles," the author described three types of ball-bearing machine tool spindles now in use, showing how rigidity is obtained in each type. The three principal groups are: (a) Two-bearing, manually adjusted spindles; (b) automatically spring-adjusted spindles; and (c) three-bearing spindles, adjustable and non-adjustable. Comparisons were made between the different types, and deflection curves and actual measurements of rigidity were quoted.

Education and Training of Executives and Engineers

In a paper covering the training of minor executives, A. J. Beatty, director of training of the American Rolling Mill Co., Middleton, Ohio, discussed the problem of maintaining a trained working force in a rapidly expanding organization. The problem of the American Rolling Mill Co. was used as an illustration of what may be accomplished through proper attention to the requirements of an expanding company and the material available in the existing personnel. Two courses—the Operating Training Course and the Sales Apprentice Course—were described. Other means of meeting new issues in the most effective manner were presented in the author's discussion of the "Foreman's Cabinet" and

the "Foreman's Forum," the former serving in an advisory capacity and the latter as an outlet for discussion.

F. L. Bishop, secretary of the Society for the Promotion of Engineering Education, Pittsburgh, Pa., considers that the two important problems of engineering education today are (1) the continuation of the graduate's education in the immediate years after leaving college, when he is going through the process of orienting himself to his profession, and (2) the selection, preparation, and development of the younger teachers in the engineering schools. In his paper on "Education and Training as Applied to the Engineer," he used, as an illustration of the organized effort to provide such graduate work, the arrangement existing between the University of Pittsburgh and the Westinghouse Electric & Mfg. Co. He then touched briefly on the increasing difficulty that is being experienced in enlisting and holding able and inspiring men in the teaching ranks.

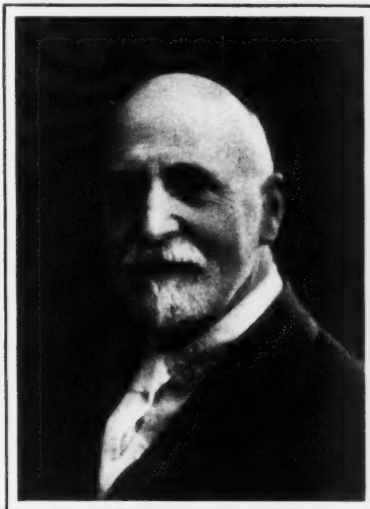
Some Common Delusions Concerning Depreciation

In a paper dealing with depreciation, Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, pointed out the effect of inflation of currency in creating illusions as to depreciation accounting. This paper shows the fallacy of the usual accounting practice that makes a depreciation allowance based on the original cost of fixed assets; the necessity of calibrating the dollar measure of value, to allow for changes in the purchasing power of the dollar; and how the present common practice results in over-statement of real profits by under-statement of actual depreciation in some cases, and vice versa in others.

Steel Corporation and Westinghouse Plants Visited

Among the plants visited by the members of the society during the meeting were the principal plants of the United States Steel Corporation in the Pittsburgh district, where the engineers were given an opportunity to see the latest developments in the making of steel. One afternoon was devoted to visiting the plant of the Westinghouse Electric & Mfg. Co. at East Pittsburgh.

The principal social event of the meeting was the dinner on Wednesday evening, May 16, when the Holley Medal was presented to Elmer A. Sperry for his achievements in the invention of the gyroscope. The Engineers' Society of Western Pennsylvania and the Pittsburgh Section of the American Ceramic Society cooperated in planning and conducting the meeting.



Alex Dow, President of the American Society of Mechanical Engineers

National Machine Tool Builders' Meeting

THE spring meeting of the National Machine Tool Builders' Association was held at the Hotel Stevens, Chicago, Ill., May 22 and 23.

An unusually large number of members were present. The discussion and the papers presented at the meeting covered a great many subjects of importance to the machine tool industry. A matter of especial interest to both machine tool builders and users was the decision relating to the next exposition of machine tools by the association. On the recommendation of the committee having this matter in hand, it was decided to hold the next machine tool exposition in the fall of 1929.

The President's Address

The president of the association, P. E. Bliss, president of the Warner & Swasey Co., Cleveland, Ohio, in his opening address referred to many of the pressing problems of the industry. On the subject of steadily increasing free service requirements, Mr. Bliss said: "As I have gone about the industry, I have heard frequent mention made of the tremendous amount of free service being demanded, and men have recited how very heavy are the costs of engineering service both for special adaptation of standard machines and for the invention and design of special fixtures and tools. In many instances, under great pressure from customers, and unfortunately as well from competition, these special adaptations or designs have been furnished at cost or less.

"Many of our members have also remarked how frequently it is necessary to change the models of machines in order to incorporate their own advancing ideas and meet the demands of the trade. These changes, of course, can be made at very heavy expense, an expense which too often must be recovered on a comparatively small volume of business, handled on a very meager margin of profit.

The "Trading-in" of Machine Tools

"One practice which has for many years been a source of loss to most of us has been that of trading in used machines as a part of the purchase price of new equipment. Some very careful studies have been made by experienced and capable men in this industry and in the dealer organizations, as a result of which a plan of having a standard appraisal system adopted in each of the larger centers has been proposed, and in at least two instances is now being tried out. Those familiar with the subject are optimistic about its possibilities, and the experience so far has been quite satisfactory. If an appraisal plan is generally adopted, it will undoubtedly tend

to correct one of the very serious and outstanding difficulties which have been present in our industry for many years.

The Importance of Standardization

"In our general sessions, I think we may very profitably consider those subjects of standardization of dimensions of certain parts, materials, etc., which are applicable to our industry at large. Some effort has been made in this direction, but the subject is one always full of fruitful opportunity. You have all had put before you from time to time, of late, information showing the remarkable strides that German industries are making in this direction, and you will have observed that this has come about more largely as the result of industry cooperation than through any outstanding achievement of individual concerns.

Relation between Costs and Prices

"Certain purchasers of machine tools continue to complain about prices, and particularly price increases. Some machine tool men have asked how they can know when a price advance is necessary and how best to present the reasons for the advance to their complaining customers. May we not properly answer in this manner? 'When you have secured all the orders that proper sales methods will permit, and when you have operated your business as efficiently and economically as you know how, if there does not remain a net profit which reasonably compensates those who should be compensated, including the stockholders, then the time has arrived for a price increase large enough to effect this; and you should not hesitate to tell any one who questions such action the simple truth that you are seeking a proper living and a safe return on your investment.'

"Our association has come increasingly into its own during the last few years because of the growing willingness of its membership to cooperate. An association can have, among its members, some value on the basis of acquaintance and friendship alone, but it begins to have its greatest value when, based on this friendship, the members frankly discuss their problems and seek a mutual solution of them. Already notable advances have been made in some parts of our industry because of the better understanding and cooperation resulting from this more intimate contact. Some of the subjects which have lately been handled to the greatest advantage, and which offer opportunity for further consideration, are those which relate to standardization of sizes, standard forms of quotations, the adoption of



P. E. Bliss, President, National Machine Tool Builders' Association

better credit and collection policies, and the analysis and proper handling of presumed departures from sound trade practices."

What is the Best Basis for Making Prices?

In a paper entitled "What is the Best Basis for Executive Policy in Making Prices?" Ralph E. Flanders, manager, Jones & Lamson Machine Co., Springfield, Vt., analyzed this question in a rather complete manner. The address is abstracted in the following paragraphs:

A price may be impossibly low; that is, it may be so low that the manufacturing company cannot maintain its solvency. A price may be impossibly high; that is, it may be so high that sales are prevented and insolvency again ensues. The practical range is somewhere between too high and too low.

Let us first examine the location of the low limit. Primarily the low limit is set by the cost of production and distribution. If the price is below the "normal cost" (by "normal cost" is meant the cost averaged over a full period of good and bad times), the manufacturer will eat up his surplus and go out of business, unless he has other more profitable lines. This is a simple and obvious fact, but it is not so simple to take practical account of it. Cost keeping is a most flexible operation. Different firms and even different accounting experts differ on the rules. The final arbiter is an honest trial balance. If the cost system says there are plenty of profits and the trial balance says the company is going down hill, there is probably something the matter with the cost system.

It is a common, even a usual, experience for a new machine to be introduced at an optimistically low price, based on faulty cost figures or estimates. Over a period of years this price is slowly raised to the point where real trial balance profits begin to appear; but meanwhile, there have been perhaps several years of losses to make up.

Factors that Limit Prices

Any one of several factors may set the top limit of price which may be successfully asked for a given product. The most obvious of these factors is competition. If other firms are selling machines at a lower cost which are of equal value in the eyes of the average customer, competition is the deciding factor. But this top limit may be raised for any individual product above the competing price if the customer can be shown that the more costly machine has a greater earning power. Value is therefore the second factor which sets the top limit.

At this point we often find ourselves out of sympathy with the purchaser. It seems to us that he makes unduly exaggerated demands in profit earning. It seems ridiculous to us that the customer should require a machine to pay for itself in six months, or a year, or two years, or even five.

But if we can put ourselves in the customer's place we get a different viewpoint. With all the ups and downs of the automotive parts manufacturer, for instance, how can he consistently look forward to a five-year period before he has paid for his equipment? He would be foolish to do so in most cases—he might reasonably do so in others. The situation is complicated by the machine tool builders' activities in bringing out new designs

which render old ones obsolete. If competition is going to force our customer to purchase new machinery—as yet undesigned—in two or three years, he must realize quickly on that which he buys now.

Patents may have an effect in raising the top limit of prices. They cannot raise it above the limit set by productive value, but they may raise it above that set by free competition, if they prevent other manufacturers from reaching the higher productive value. If patents give too high a margin of price difference, however, their tendency is to stimulate competitive inventive genius. Sheer selling ability may also sustain a price above competing machinery of equal value. Old established reputation may do the same. More legitimately, a contemporary reputation for prompt, intelligent, and continuous service and scrupulous fairness of dealing will have the same profitable result.

We have now examined the upper and lower limits of price. The low limit is set by normal cost. The high limit is set by competition and productive value, and may be modified by patents, selling ability, and reputation. Just for a moment, before we discuss where the price should be set between these limits, let us consider whether it should ever be set outside of them; that is, whether a price should ever be set below normal cost.

Should One Ever Sell Below Cost?

It is not true to say that it has never paid to sell below cost. History is against this view. A classic example of profitably selling below cost is shown by Mr. Carnegie, who during hard times cut his prices to a point below the profit line, but down to a figure which enabled him to hold his organization and maintain its productive efficiency. This was good for Mr. Carnegie, but it was not good for the steel industry as a whole. The present policy of the United States Steel Corporation is without doubt better for all concerned. The fact remains, however, that Mr. Carnegie made a personal success of the other policy.

It would be difficult to duplicate his personal success today. The capital resources of the country are so large, manufacturing ability is so much more widespread, and other factors have so evened up that it would be very difficult indeed for a single competitor in any line of work to attain the commanding position that Mr. Carnegie occupied.

Low Prices do not Increase Machine Tool Sales

A more serious objection relates to the nature of the machine tool business as one of the equipment industries. There is a considerable demand for steel even in dull times, which can be stimulated by a price reduction. This is still more true of staples like clothing. But when hard times come on, the greater part of the machine tool market is not dormant, it is stone dead. Reducing prices in hard times does not increase sales. It merely increases losses. We may say definitely that selling machine tools at any time below cost is useless.

Before leaving this question of cost, let us make sure we leave nothing out. Cost includes, of course, labor, material, and manufacturing and selling overhead. In the overhead are included salaries of all necessary officials on a scale not exorbitant, as compared with business in general; also deprecia-

tion sufficient to care for replacement of productive capacity of plant and equipment as it deteriorates by wear or obsolescence. There must also appear in the cost a sufficient item to carry on the necessary development work, to maintain the company's competitive position.

The selling price must also be high enough to provide legal interest, through good times and bad, on that part of the net worth of the company which is actively engaged in the business. This excludes, for instance, more or less permanently invested resources, which should carry themselves. All these are elements of cost, and must be met by the selling price if the firm is to continue to exist. As profits, we will class anything in addition to the foregoing elements of cost such as extra dividends above the minimum, increases in plant financed from earnings, etc.

How to Use the Figures After they have been Ascertained

When the manufacturer examines his position from this standpoint, he will find himself in one of two conditions, and will have to solve one of two problems. He may find himself without profits, and have to decide how to get them. Or he may find a profit margin, and have to decide how much of it he will take. Let us consider the first contingency.

There has been a tendency to consider that the only answer to this problem is to raise prices. At the best, this is only half the answer. The opportunities to improve the situation by reducing costs should also be attractive. There are few shops in which an intelligent campaign would not result in lowered manufacturing cost. Skillful redesign of the product, with an incidental standardization of certain parts and materials, will also help. Better production and stock control to release frozen capital will help. Good management in general must be a first factor, not a secondary one, in producing profits.

There are conceivably cases in which an actual lowering of the price will increase the profit by decreasing costs of manufacture. This has been true of automobiles. It could be true for machine tools only in the case of standard, general-purpose machines. The high production machines have so much about them that is special, and their design is subjected to such frequent improvements, that such a policy would be ineffective.

One of the severest cost handicaps is excessive plant capacity. We are not yet adjusted from war and pre-war capacity to the status required by a developed country. The drastic step of liquidation for some part of the assets may be necessary. But there is still the resource of raising prices, and this is a perfectly legitimate remedy if it can be done. The assumption was, however, that the top line, as determined by outside conditions, was too near the cost line to permit of a profit. To raise prices, therefore, something will have to be done besides sending out a new price list.

If competition sets the top limit, our manufacturer must consider whether or not his competitors are prospering. The best recourse is to the government census reports, where the inquirer will learn that the industry as a whole is in a most unenviable

position on the profit question. If there seems to be real reason to believe, however, that competitors are prospering, our manufacturer will have to go back and dig into his manufacturing and engineering problems again, or get out of the business.

If his competitors are not prospering, then the whole industry is on an unsatisfactory plane, and it is legitimate and desirable to recognize the fact. If the distressed individual manufacturer cannot arouse the industry as a whole, he has still the recourse of so raising the value of his product, and rendering such service to his customer, that he can obtain profitable prices above the general level.

The Basis of Fair Profits

But let us suppose the second case—that existing conditions offer a considerable profit as we have defined the term. How much of that profit shall he take? Various suggestions have been made, among which are the following:

1. The manufacturer should settle on a certain percentage as a fair profit to add to the cost of manufacture.
2. The sale price should be set so that the profit is a certain percentage of it.
3. The sale price should be set to provide certain ideal dividends and reserves in relation to the capital stock.
4. The ideal profit should bear a certain relation to net worth; or to book value of investment; or to replacement value of total assets.
5. Profits should bear a percentage relation to conversion cost.
6. The principle that the writer is willing to subscribe to as the best guide is, however, *to set the figure at the price that will bring the highest continuous returns. Continuous returns indicate satisfied customers.*

Costs are not rigid things. They may be manipulated by engineering and managerial skill. Selling prices are not inflexibly fixed by competition or by arbitrary printed lists. They may be raised and justified in the purchaser's mind by increased service and greater profit return to him. The highest returns are not to be obtained by setting arbitrary standards, but by applying to the business every available ounce of engineering, manufacturing, selling, and financial ability, and applying them to render a maximum of service to the customer.

Trading Old Tools for New

In a paper on the trading-in of old tools when new tools are purchased, J. R. Porter, president of Marshall & Huschart Machinery Co., Chicago, Ill., outlined a method of handling appraisals for trade-in deals that has been successfully applied in Chicago, New York City, and Middle New York state. He pointed out the unsound features of permitting the placing of an order for a new, valuable, profit-making machine tool to be contingent upon the amount that a machine tool manufacturer or dealer will allow for an old, more or less worn out piece of equipment that is practically unsaleable. He also quoted a resolution unanimously passed by the Associated Machine Tool Dealers asserting that "We believe that the present method of making allowances for used machines in exchange for new ones is not founded on good business principles."

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

MORTON JOURNAL-BEARING FINISHING MILLER

A machine designed especially for finishing in one operation the bearing surface, fillets, and ends of American Railway Association standard car journal bearings after they are babbitt-lined, has recently been brought out by the Morton Mfg. Co., East Broadway and Hoyt St., Muskegon Heights, Mich. The chuck provided for holding the bearing brasses is of box construction, and is provided with rotating jaws which close and open automatically as the chuck is raised and lowered to and from the cutter.

The heights between which the chuck moves in an operation are adjustable to suit different sizes of bearings. Adjustments are accomplished by means of a quill which is threaded on its lower end and equipped with adjustable lock-nuts. These lock-nuts are provided with eight slots suitable for the application of a spanner wrench. In making a final vertical adjustment, a movement equal to the center distance between the slots on the nuts causes a vertical movement of the quill of $1/64$ inch. Steel jaws which can be quickly placed in position on the chuck or removed are furnished for the various sizes of bearings.

Power for raising and lowering the chuck to and from the cutter in a milling operation is applied through levers, adjustable connections, a shaft, and a special cam. The cam is so designed that the work moves upward quickly until it comes in contact with the cutter, after which it feeds into the cutter at a slow rate. Upon the completion of the operation, the chuck is quickly lowered, and during the return movement the jaws are automatically released, leaving the work free to be removed.

An eccentric adjustment provides means whereby an additional amount of stock can be removed from the work surface, should it be desirable to raise the cutter to the work a second time. There is a quadrant having three notches, each of which permits an adjustment of the work toward the

cutter equal to 0.026 inch. When a bearing does not "clean out" well in the first cut, a lever may be adjusted one notch on the quadrant as the chuck returns to its down position, so as to insure a good finish on the second cut. Third and fourth cuts can also be taken, when necessary, without removing the work from the chuck.

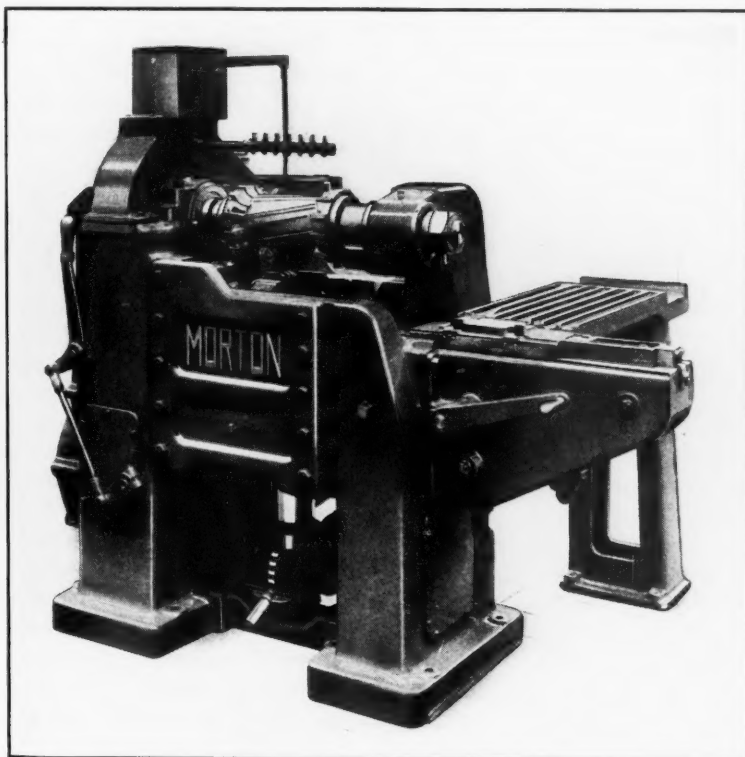
The control lever is within easy reach of the operator. A special friction clutch permits instantaneous starting and stopping of the machine. Automatic stopping occurs when the chuck reaches

its lowest position. Power for driving the machine may be supplied by a direct-connected constant-speed motor of either alternating or direct current type. A countershaft drive can also be provided for. The motor is mounted on a bracket provided with adjustments for placing the driving belt under proper tension. When the machine is electrically operated, a push-button control for starting and stopping, is located within easy reach of the operator.

There is an outer bearing for the cutter-arbor which is tongued and fitted

to a centering slot and held in position by means of two bolts. This bearing may be quickly removed to enable easy replacements of the cutter. Cutters are made with adjustable steel blades which may be readjusted as required after sharpening. The fillet milling cutters are secured to the body of the journal sizing cutter, and may also be adjusted to meet requirements.

Lubrication of the cutter is accomplished automatically by gravity from a tank on top of the gear-case. A valve is opened by levers and by a vertical rod that is lifted by the chuck, to supply lubricant as the work straddles the cutter, and this valve is closed as the chuck returns. The arrangement insures the delivery of the proper amount of oil to the cutter. A manifold equipped with needle valves is used to regulate the drop and distribution of oil for the various sizes of cutters. There is also an automatic oiling system for all bearings in the main column, the oil being taken



Morton Milling Machine for Finishing Railway-car Journal Bearings

from a compartment in which the cam operates. Oil is carried at such a level in this compartment that the cam becomes covered with it during each revolution. A rotary pump draws oil from this tank and discharges it into a receptacle in the main gear housing, from which it is delivered through tubes to the various bearings and to the main driving gears. After being used, it is returned to the supply tank.

A bearing loading carriage on the right-hand column enables the operator to load and unload work without any chance of injury from the cutter. After a bearing has been placed on the sliding plate, it is advanced into the chuck central with the cutter by merely moving the lever toward the left. When the operation is finished, the lever is moved to the right to withdraw the bearing from the chuck.

A chipping and inspection bench equipped with V-blocks to suit the various sizes of bearings can be attached to the loading bracket, as shown. This bench is supported by a pedestal at the outer end and has a finished top surface. With this bench, only one lifting of a bearing is necessary during the entire finishing operation.

CINCINNATI BRAKE-DRUM GRINDER

Internal and external surfaces of hardened steel brake-drums are ground simultaneously in a machine recently developed by the Cincinnati Grinders, Inc., Cincinnati, Ohio. All major movements of the machine are accomplished by air pressure to eliminate the hard physical labor usually involved in obtaining rapid production on a machine of this type. The machine has two independently driven and operated work-heads.

As illustrated in Fig. 1, the machine is arranged for grinding drums mounted on the hubs; a different work-holding device is employed for grinding unmounted drums. The drum assembly is held rigidly against the faceplate by an instantly operated air chuck, being located from the hub. The entire saddle carrying the work-head is moved to and from the grinding position by air under pressure.

A three-horsepower variable-speed direct-current motor, controlled by a convenient rheostat, drives the work-head. Rotation is started and stopped

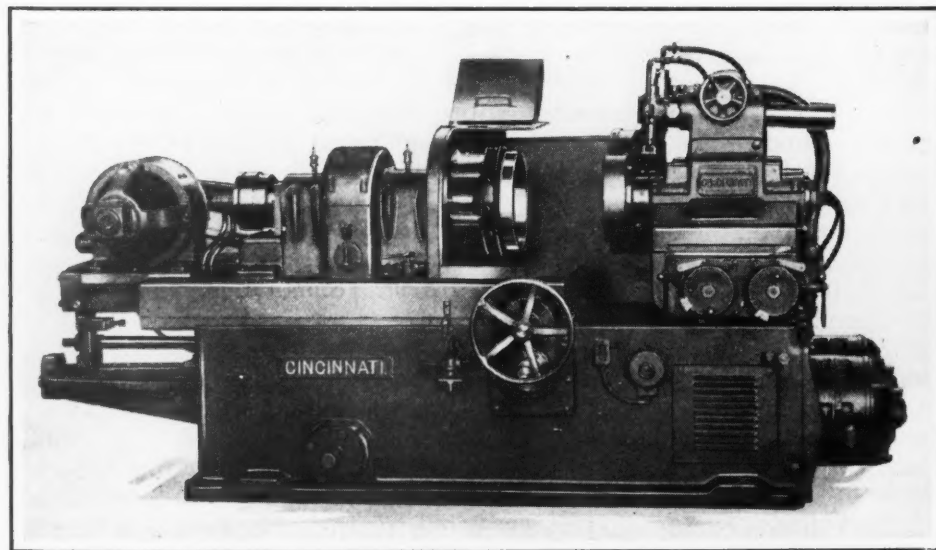


Fig. 1. Cincinnati Machine which Grinds Interior and Exterior of Brake-drums

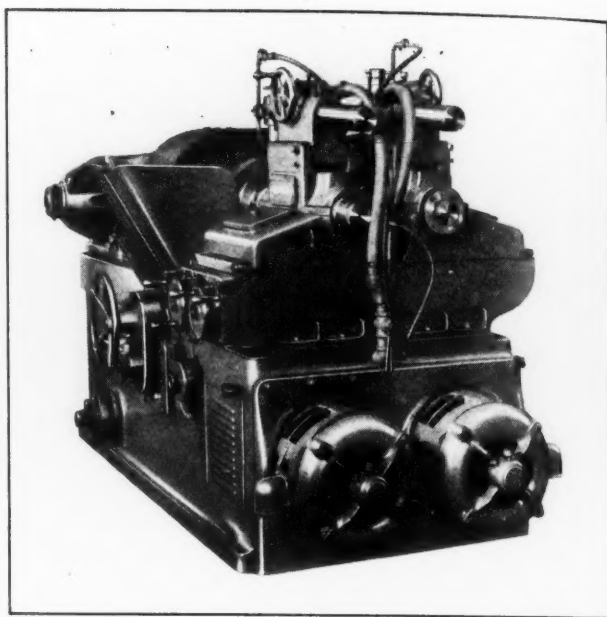


Fig. 2. End View, Showing Arrangement of the Two Wheel-heads

through a push-button control, the motor being equipped with a dynamic brake for stopping instantaneously. The drive is through a multiple-strand "Texrope," a worm, and a worm-wheel keyed to the work-head spindle. Speeds of the work-holding device, ranging from 1 to 44 revolutions per minute, are available. Provision is made for mounting a generator on the back of the machine to supply direct current to the headstock motor in shops where this current is not available. The generator is driven by a silent chain from one of the main drive motors.

When work is moved up to the grinding position, a permanently located stop acts on the air valve to facilitate rapid positioning in relation to the grinding wheels. A hand-operated rack-and-pinion mechanism permits hand-traversing of the work-head in setting up the machine. The V-ways are automatically lubricated by rollers, which dip into oil-wells placed at intervals along the ways. When in the grinding position, reciprocation of the work-head is automatically effected by means of a cam mounted on the under side and driven by a chain from the headstock spindle.

Each of the wheel-heads is driven by a 20-horsepower, constant-speed motor. These motors are semi-enclosed in the bed of the machine, being mounted on a single bracket directly beneath the grinding wheel spindles, as shown in Fig. 2. Multiple-strand "Texrope" drives are used to deliver power straight from the motors to the spindles.

Lubrication of the wheel-spindles is accomplished automatically by centrifugal slingers on the spindles, which lift oil out of the reservoirs in the wheel-head and distribute it into

pockets in the spindle caps. The in-feed movement of the wheel-heads is independently controlled, and is adjustable by means of two handwheels on the front of the machine. These handwheels are graduated to read to 0.00025 inch on the work diameters. The mechanism is so arranged with a lever and latch that the heads may be moved into the work by an up and down hand motion, the amount of in-feed being adjustable through set-screws. Positive stops facilitate duplicate sizing.

The front spindle carries a 14-inch wheel for internal grinding, and the rear spindle, a 20-inch wheel for external grinding. Both wheels are counterbored the same and so arranged that when the larger wheel becomes worn it can be transferred to the internal grinding spindle, thereby permitting full use of wheels. Hand-operated wheel truing fixtures are mounted on the wheel-heads.

Coolant is supplied by an independently driven pump from a tank built into the bed. The pump valve is opened by the work-head as it reaches the grinding position, and is automatically closed as the work-head is withdrawn. Separate pipes which carry coolant to the wheel dressers are controlled by hand-valves. In a test, this machine simultaneously ground, from the black, the interior and exterior diameters of drums mounted on hubs, at the rate of thirty drums per hour.

BROWN & SHARPE PLAIN GRINDING MACHINES

A new series of plain grinding machines designed for heavy-duty service has been added to the line of machine tool equipment built by the Brown & Sharpe Mfg. Co., Providence, R. I. There are three sizes of these machines, all of which are similar except for the bed length. These Nos. 30, 32, and 33 machines take work up to 18, 36, and 48 inches long, respectively, between centers. The centers swing work up to 12 inches in diameter with 24-inch wheels having faces from 2 to 10 inches wide, and work up to 6 inches in diameter with 30-inch wheels having faces from 2 to 6 inches wide.

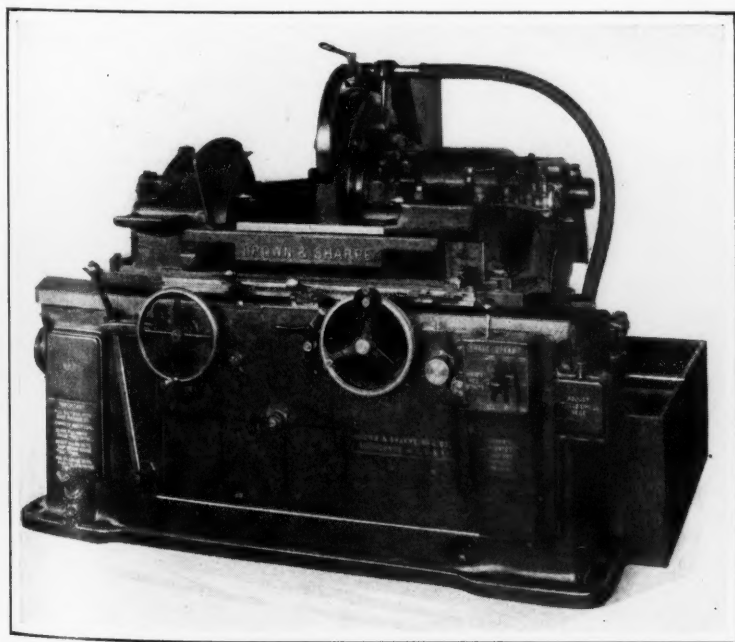


Fig. 1. Brown & Sharpe Plain Grinding Machine with Narrow Wheel

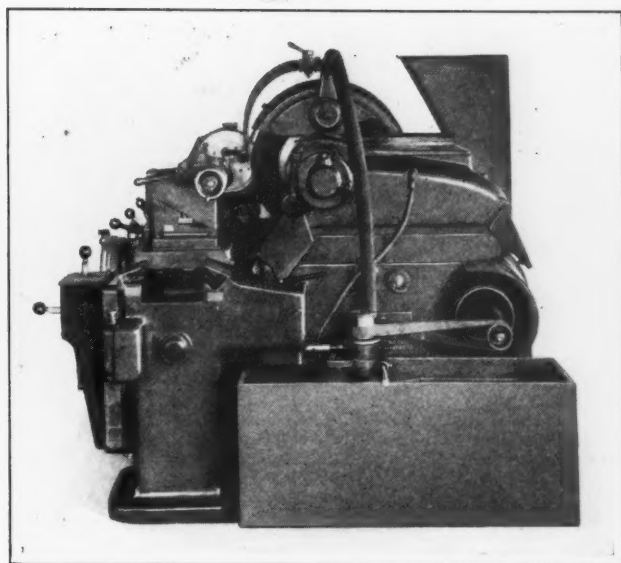


Fig. 2. Construction of Machine as Viewed from Right-hand End

The machines are essentially production units, and possess a wide range of table and work speeds. Table speeds from 25 to 373 inches per minute are available, and work speeds from 61 to 270 revolutions per minute. Owing to a table dwell provided at each end of the table traverse and a shock absorber in the reversing mechanism, high table speeds can be used without affecting the finish of work. It is claimed that the dwell affords a finish on the work ends that is usually difficult to attain.

All control levers are conveniently grouped in the normal operating position. Changes in speed of the work unit are made by operating in an H-slot the lever on top of the box seen at the right-hand end of the bed, while the various table speeds are obtained by moving the lever on the front of the box in the different slots. Cross-feed controls, for both automatic and hand operation, are located about the handwheel. There is an adjustment for the table dwell at the right.

The machines are made heavy to insure accuracy, and the work drive has been made smooth by the combination of a torsion shaft and a balanced belt drive from within the machine. The wheel-slide and wheel-slide base have long automatically lubricated ways to insure alignment and full support of the wheel-spindle, even when in the extreme positions. A reciprocating attachment may be provided on the right-hand end of the wheel-spindle to furnish a 1/8-inch automatic movement to the spindle. This attachment is made non-operative through a lever, when not required. Both spring lever-and-screw and hand-wheel operation are provided for the footstock.

Lubrication of the wheel-spindle and all main mechanisms is accomplished by the gravity flow of filtered oil from a reservoir flooded by means of a hooded pump. The oil filters are readily accessible for cleaning. The few necessary oiling stations are marked with instructions concerning frequency of oiling. Moving parts and scraped surfaces are guarded in all positions.

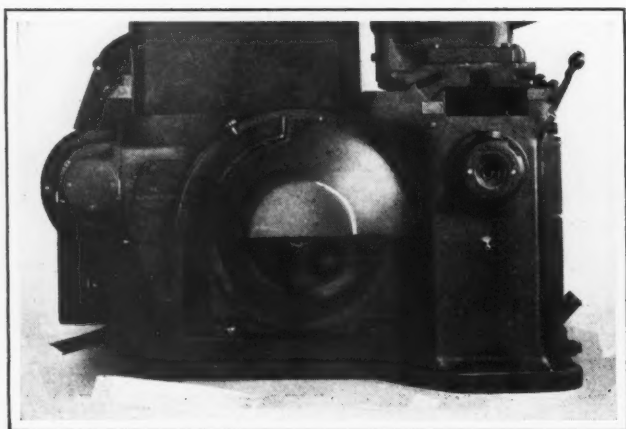


Fig. 3. Hooded Housing which Encloses the Motor of Motor-driven Machines

Either an overhead countershaft drive or a motor drive is available. Figs. 1 and 2 show a machine arranged for a belt drive. When motor-equipped, the motor is enclosed in a compartment cast in the base, as illustrated in Fig. 3. The compartment is hooded in a way that protects the motor and yet affords easy access for lubrication. A motor of from 15 to 40 horsepower is required, depending upon the work. The motor-control equipment may be mounted on a stand close to the base of the machine and within the floor space limits. One main motor drives the entire machine.

A complete line of equipment is available for these machines to adapt them to a wide variety of plain cylindrical work. Each of the machines is built in two modified forms for work not requiring all the automatic functions. The first form, known as the "A" machine, has hand operation for the table, with one power table feed for wheel truing. It is particularly adapted for straight in-feed grinding, using either power or hand cross-feeds. The second machine is known as the "B" machine, and has only hand table and cross feeds. This machine is also intended for straight in-feed grinding, using the hand cross-feed only.

CINCINNATI ALL-STEEL PRESS BRAKE

An all-steel press brake of new design and size, recently placed on the market by the Cincinnati Shaper Co., Elam St. and Garrard Ave., Cincinnati, Ohio, is shown in the accompanying illustration. This No. 120 series press brake has a capacity for making right-angle bends, with one stroke, in 3/8-inch steel plate 8 feet long, over a 3-inch die opening; or in 1/4-inch steel plate 12 feet long, over a 2-inch die opening, without overloading.

The construction of this machine is different from others previously built by the concern in that the housings are made of a single plate, 4 1/4 inches thick, instead of being constructed from double plates arranged in box section. When machines of this type were first designed, it was necessary to use two 2-inch plates, welded and riveted together, in order to make a housing 4 inches thick, as it was impossible to obtain plates of the required size

and thickness rolled flat enough for this type of construction. At present, plates 6 inches thick are being rolled sufficiently flat.

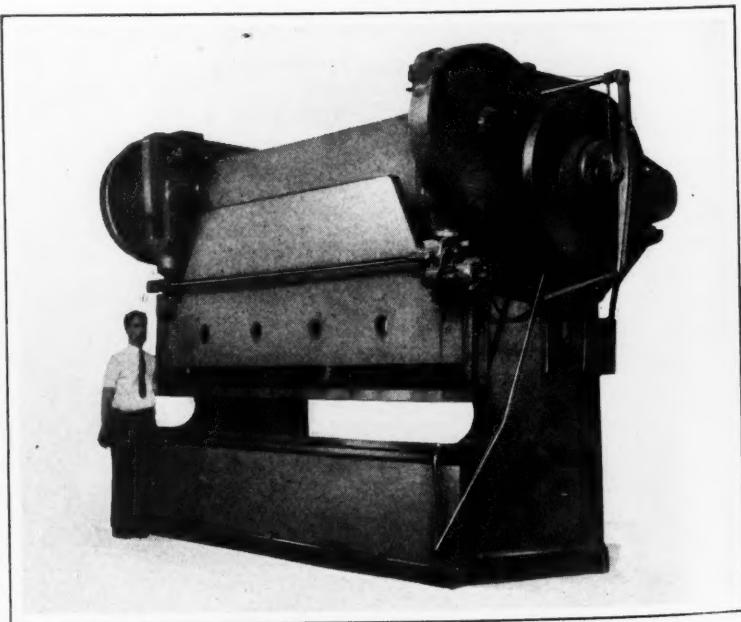
The bed and ram plates of the new machine are 3 inches thick. The bed extends below the floor line from 18 to 28 inches, depending upon the length of the machine. Owing to the method of mounting the bed and the divided connecting-rods, which are a patented feature, loads are carried directly up and down on the center lines of the housings. The left-hand divided connecting-rod can be clearly seen in the illustration. Connecting-rods of this type were also a feature of the machine described in November, 1925, *MACHINERY*. The construction practically eliminates deflection and gives greater capacity with the same factors of safety.

Other features of construction of the machine include automatic oiling, anti-friction bearings on high-speed shafts and in the flywheel mounting, a special disk clutch, a large over-size brake-drum, liberal depth of the bed and ram plates, and screws made of high-carbon high-nickel steel, with buttress threads. A dovetail slot planed the length of the bed, both on the front and back, provides for the attachment of gages and other fixtures.

The machine is arranged with a motor drive, the motor being connected to the flywheel through a "Texrope" drive. The ram is raised and lowered by means of an independent motor. Standard machine lengths in this new series range from 6 feet 6 inches between the housings, with a die surface of 8 feet; to 12 feet 6 inches between the housings, with a die surface of 14 feet.

"GAGE-MATIC" INTERNAL GRINDING MACHINE

An internal grinding machine which embodies a positive gaging device that particularly adapts it for production grinding of straight open-end work, such as ball-bearing parts, gears, and bushings, is being placed on the market by the Heald Machine Co., Worcester, Mass., under the trade name of



Cincinnati All-steel Press Brake

"Gage-Matic." The method of sizing is the same as that employed for years in the "Teromatic" internal grinder previously built by the Giddings & Lewis Machine Co., Fond du Lac, Wis. As announced in September, 1927, *MACHINERY*, the complete interest of that concern in its line of internal grinding machines was recently purchased by the Heald Machine Co.

The "Gage-Matic" is a companion machine to the "Size-Matic" described in September, 1927, *MACHINERY*. It has the same base, with the hydraulic drive to the table, the same wheel-head, wheel-truing device, and motor and belt main drives.

The gaging device on the "Gage-Matic" differs from that on the "Teromatic" in that a single disk controls the sizing and permits the grinding of fairly short work. The control for "short-stroking" the table at the proper time to enable the wheel to be trued is on the cross-slide, similar to the arrangement on the "Size-Matic," where a single electric contact point governs this operation.

The size-gage mechanism operates in conjunction with the work-head, and consists of a gage mounted on the end of a rod that revolves concentrically with the work-spindle and reciprocates in synchronism with the main table. As the front end of the wheel clears the back of the hole, the gage is firmly pressed against the piece at this point. The sizing is complete as soon as the gage enters the hole, when an electric contact is made and the entire machine goes into the rest position.

Provision is made through the work-spindle for the sizing gage rod, a water pipe, and a fixture-operating tube, which is hydraulically actuated to produce a push or pull movement as desired. This arrangement is furnished on order only. A large supply of water is delivered to the work through the work-spindle or on the wheel-spindle, as desired. The water supply starts and stops automatically with the work-spindle.

The cycle of operations is fully automatic, when the operator has once chucked the work and thrown over the starting lever. The wheel then enters the work and rough-grinds at a roughing speed and feed until only a predetermined amount of stock is left, when a contact is made on the cross-slide. The table then makes short strokes and changes to a

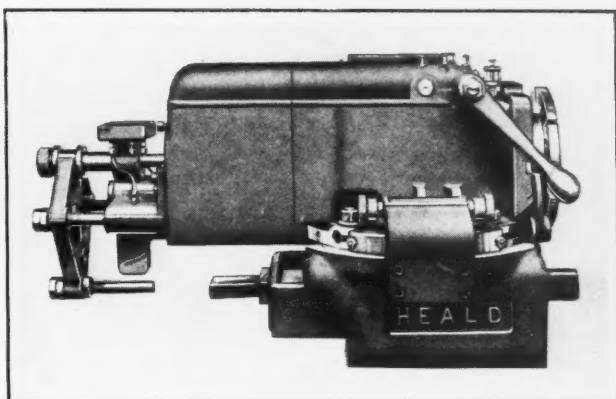


Fig. 2. Close-up View of Work-head and Size-gage Mechanism

truing speed, and the diamond drops into position for truing the wheel, after which the wheel again enters the work and grinds with a finishing speed and feed until the gaging plug enters the hole. Then a second electric contact causes the wheel to leave the work, and the entire machine comes into the rest position as already mentioned. The work is chucked from the front and held by quick-acting oil-operated fixtures.

The work-head is mounted on a bridge which is bolted to the base. The swivel circle has been enlarged to 16 inches in diameter, and movement is obtained through knurled knobs on the front of the bridge. The work-spindle has a flange 9 1/2 inches in diameter which assists in lining up chucks or holding fixtures. It runs in self-adjusting radial ball bearings. The work-spindle pulley is also mounted on ball bearings and has a multiple-disk clutch on the inside, which gives a positive drive, while a separate multiple-disk brake stops the spindle as the pulley clutch is released. While this brake works automatically when grinding, it can also be operated by hand.

The wheel-truing operation is controlled from a cross-slide through a slip ring carrying a stop that engages a finger at a set point. This forms an electric contact that permits current from a generator on the back of the machine to energize a magnet which actuates various levers and dogs necessary to operate the table at short strokes and drop the diamond into position for truing. The same slip ring, after engaging with the finger, allows the handwheel to progress further, with each successive work piece, by an amount approximately equal to the reduction of the wheel due to grinding and dressing, and thus compensates for wheel wear.

Some of the important specifications of the machine are as follows: Swing over table, 15 3/8 inches; swing inside of standard water guard, 11 1/2 inches; maximum diameter of hole that can be ground, 5 inches; total floor space required, 114 by 56 3/8 inches; and net weight of machine, 4800 pounds. The length of hole that can be satisfactorily ground depends on the diameter of the hole and the shape of the work, 8 5/8 inches being the maximum working stroke of the wheel-head.

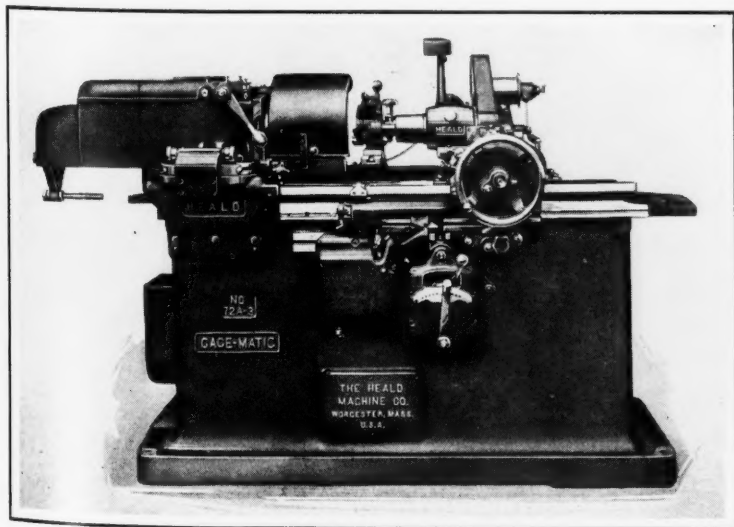


Fig. 1. "Gage-Matic" Internal Grinding Machine with Sizing Feature

NORTON TRI-MOTOR UNIVERSAL GRINDING MACHINE

Three separate motors drive the headstock, grinding wheel, work-table and pump of an improved 12- by 36-inch universal multi-purpose grinding machine recently placed on the market by the Norton Co., Worcester, Mass. This machine is designed as intermediary equipment between the tool grinder and the heavy production machine. It permits the handling of small lots of parts too heavy for the tool grinder and yet not sufficient in quantity to warrant the use of a heavier machine. It performs external, internal, and face grinding.

The wheel drive is from a motor mounted on the wheel-slide; the table drive is from a back-shaft driven by a motor mounted directly on the rear of the machine, as shown in Fig. 2; and the work drive is from a motor mounted on the headstock. The table drive motor also operates the pump for supplying water or compound to the work. Each motor is individually controlled. A generator operated by the table-traverse motor may be provided

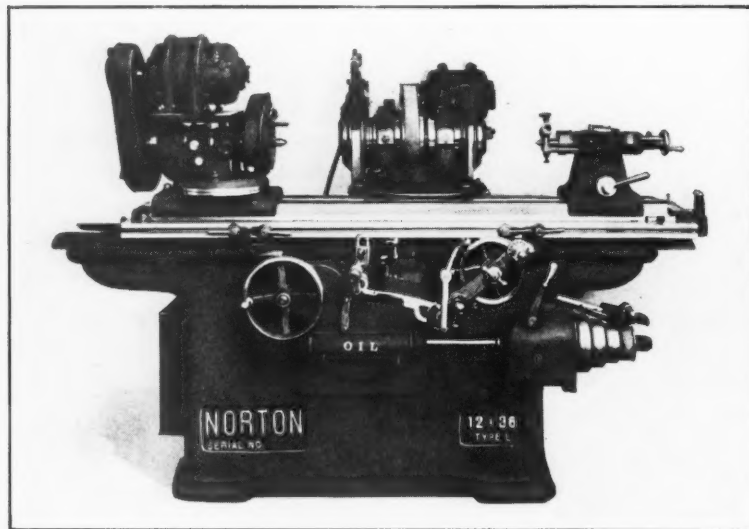


Fig. 1. Norton Universal Grinding Machine Driven by Three Motors

for the work-drive motor when direct current is not available.

Gearing, shafting, and belting within the machine are eliminated by the use of the three motors. Virtually all important mechanisms are on the outside, where they are easily accessible. Although essentially a light machine, it is built rigidly to swing work up to 14 inches in diameter, and pieces up to 37 inches in length can be ground.

The construction of the headstock and wheel-head permit grinding a wide variety of pieces, both of these units being of a swivel type and having bases graduated in degrees. Positions are provided on the headstock to facilitate face grinding operations. The wheel-head may be swiveled through 180 degrees to bring into position the internal grinding spindle, which is mounted permanently on the double-ended wheel-head. Intermediate positions for external angular grinding are also possible. A chuck may be attached to the headstock spindle to handle small work that cannot be held on centers.

The footstock is of a combination lever and screw type designed to facilitate the changing of work

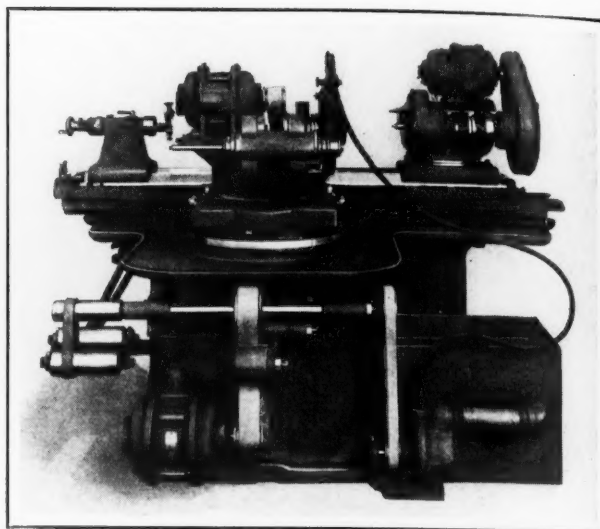


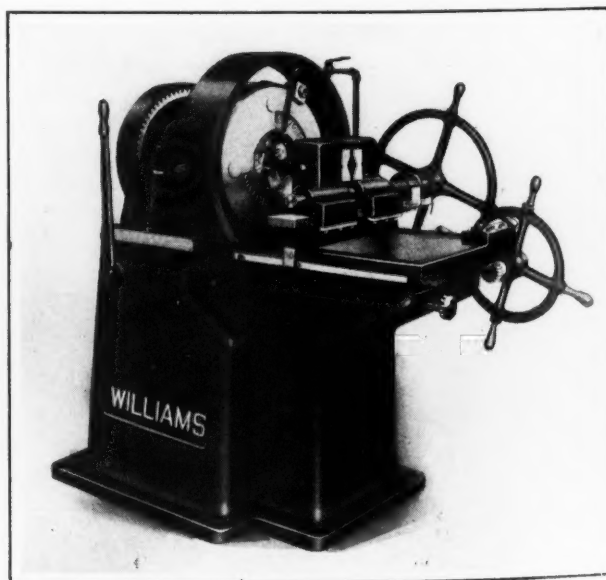
Fig. 2. View Showing the Table-drive Motor and Internal Grinding Spindle

held between centers. The work-table is made in two parts, of which the top pivots on a stud in the center and may be clamped at both ends. Graduations in degrees, with which the table is provided, facilitate taper grinding operations. Eight table speeds, ranging from 21 to 111 inches per minute, are available.

The wheel feed, either automatic or by hand, operates regardless of the position of the cross-slide relative to the work-table, and the wheel may be fed at any angle. An automatic stop arrests the feed when work has been ground to size. The reverse mechanism is the same as on all Norton cylindrical grinding machines.

"RAPID ROTARY" PIPE AND NIPPLE THREADER

A "Rapid Rotary" machine designed for the quick-threading of bent pipe and nipples has just been placed on the market by the Williams Tool Corporation, Erie, Pa. This machine has a range of spindle speeds that



Williams "Rapid Rotary" Pipe and Nipple Threader

give an average cutting speed of 19 surface feet per minute. Burrs are removed from the pipe as threads are being cut. Another time-saving feature is an automatic die trip, which consists of a cam and lever device that automatically releases the dies from the pipe the instant that the thread is finished. This cam and lever trip is controlled through the handle at the front of the machine. Chucking and releasing of the pipe are thus quickly and easily accomplished.

High-speed steel dies only are used. These are small, inexpensive, and weigh only a small fraction as much as ordinary dies. They are easily handled. Four sets of dies cover the entire range of the machine. The machine regularly threads from 1- to 4-inch pipe, and, in addition, can be used to advantage on pipe from 1/2 to 3/4 inch in size.

LINCOLN ELECTRONIC-TORNADO WELDING MACHINE

In February *MACHINERY*, on page 488, were described the advantages of the electronic-tornado principle of welding announced at that time by the

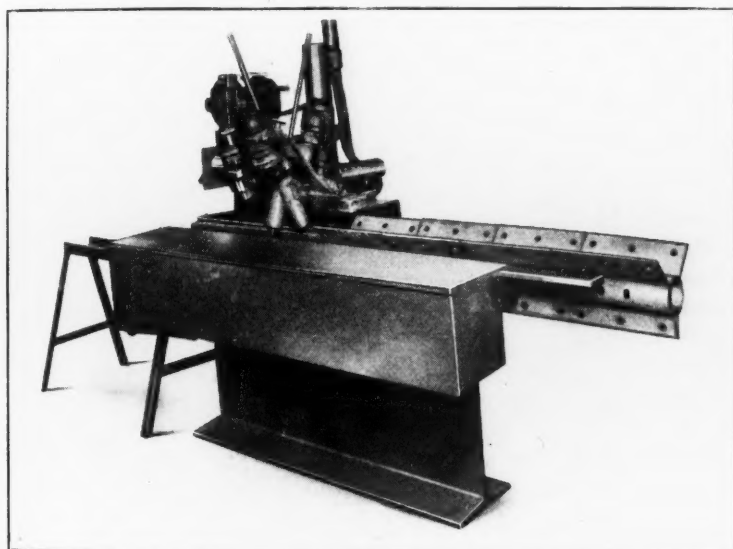


Fig. 1. Lincoln Welding Machine which Operates on the Electronic-tornado Principle

Lincoln Electric Co., Coit Road and Kirby Ave., Cleveland, Ohio, after several years of research. This concern has applied the new welding principle to the machine illustrated in Fig. 1 which is now being placed on the market. The machine is designed for producing oil-well tubular derrick-corner clamps, such as shown at the center of Fig. 2, which are made from the three pieces of plate grouped with the finished part. The plates are bent to the proper radii and are tack-welded together before being brought to the welding machine. In the tack-welding, the parts are closed around a mandrel and welded at the ends.

These assemblies are then carried under the arc of the welding machine illustrated, by means of a chain having dogs at proper intervals. It will be seen that the machine has two new-type welding heads, with their electrode-holders crossing each other at a sharp angle. With the electronic-tornado method, this construction, in which two flames are in close proximity, is possible because of the arc

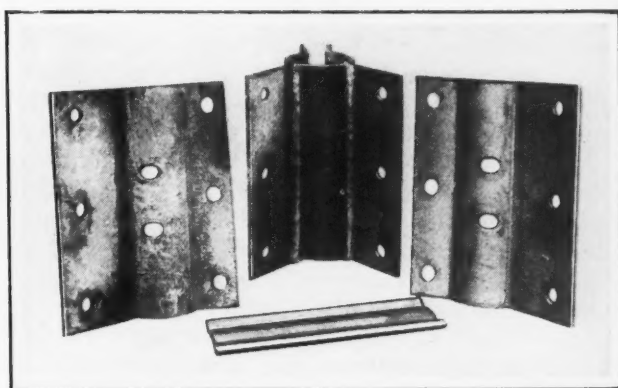


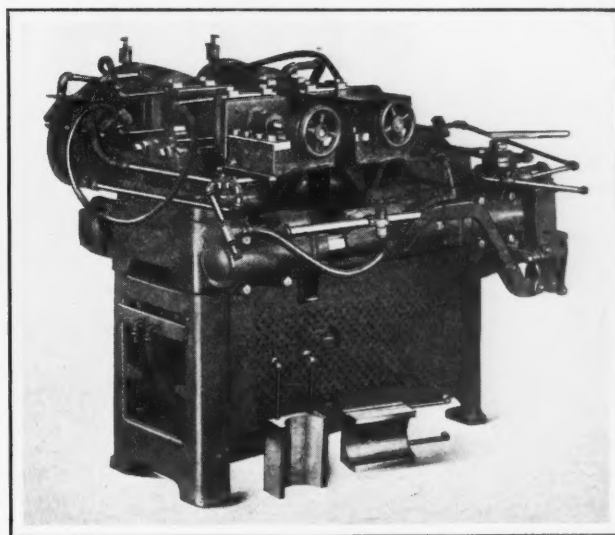
Fig. 2. Welded Part and Three Plates from which it is Constructed

control. The two flames work smoothly in conjunction with each other, fusing the plates together without the use of filler rod. Each head welds at the rate of about 40 feet per hour. The machine itself is of welded construction throughout. The process employed by the machine can be applied to the welding of all kinds of tanks, pipe, and similar work.

THOMSON FLUE WELDER

Boiler flues from 2 to 6 inches in diameter can be handled by the model No. 55 flue welder recently brought out by the Thomson Electric Welding Co., Lynn, Mass. This machine has a frame of the side-rail type with the sliding or moving platen bolted direct to the side rails. These rails are round and have bearings at the extreme right- and left-hand ends of the frame, where they are out of danger of becoming burned or pitted by flash or dirt. In addition, they are protected by sheet-metal guards, wipers, etc., to make them flashproof.

The transformer is of 150 kilovolt-amperes capacity, and is wound for any standard voltage of 60-cycle, single-phase alternating current. Operating control of the primary circuit is through a push-



Thomson Welder for Boiler Flues

button conveniently mounted and connected to the operating coil of a power-line solenoid switch. The secondary is made of cast copper and is water-cooled, the water being conducted through seamless steel tubing cast integral with the secondary.

Air-operated clamps of the horizontal type are provided. There is no sliding-surface electrical contact, the current being carried from the terminal blocks of the transformer to the die-blocks of the clamp directly by means of a flexible lead construction. All steel-to-iron or steel-to-steel sliding surfaces on the clamps are protected from flash or dirt by guards. The Alemite lubricating system is used throughout. Valves for controlling the air supply to the clamp cylinders are conveniently located. The die-blocks are adjustable in and out for obtaining accurate alignment of flues.

The dies are made of cast copper, and are water-cooled. They are 9 inches long by 3 3/4 inches thick by 7 inches high. In their central portion, they are relieved so as to give a higher unit clamping pressure on the flues. The pressure device is of the hand-operated oil-jack type, consisting of a cylinder actuated by a hand-operated oil-pump. The complete unit is mounted on the welder frame. It will produce a total pressure of about 9 tons on the cylinder ram. This machine is 50 inches wide, 60 inches long, and 53 inches high. It has a net weight of 6800 pounds.

LEWIS SEAM-WELDING HEAD

A Lewis welding head which is applicable on any ordinary spot-welder for performing seam-welding operations at speeds up to 25 feet per minute, for the lighter gage metals, is being introduced to the trade by the Welding Appliance Co., 2111 W. Lake St., Chicago, Ill. This head will weld two pieces of No. 16 gage stock, provided the spot-welder to

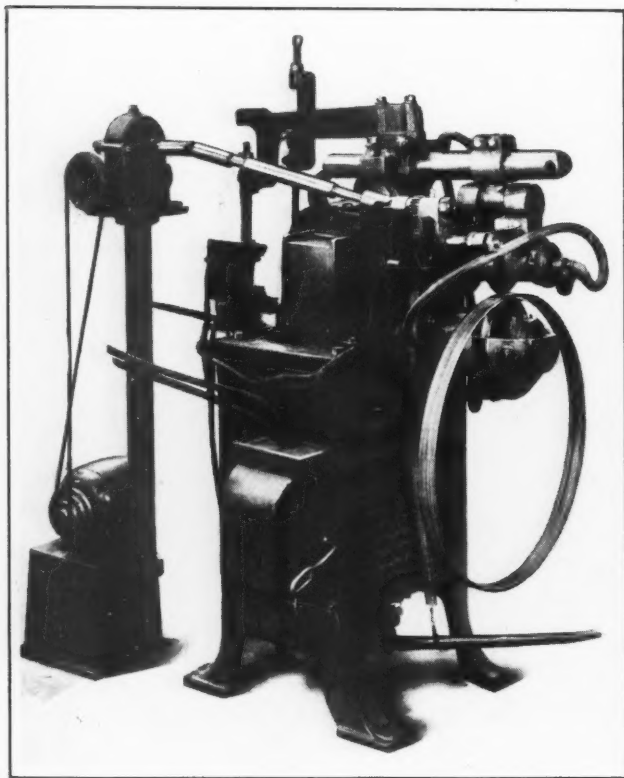


Fig. 1. Lewis Seam-welding Head Applied to a Federal Spot-welder

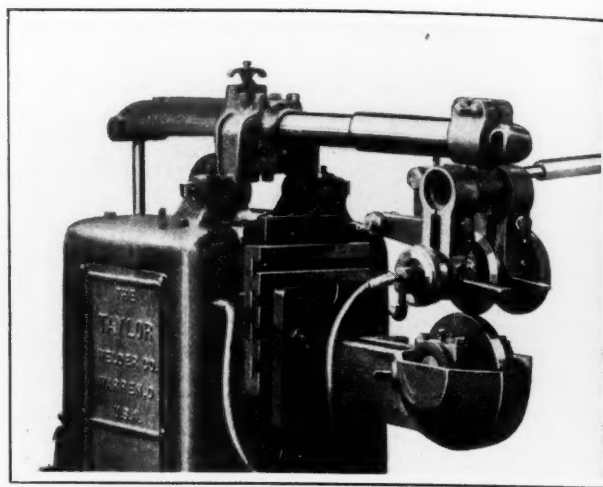


Fig. 2. Installation in which the Electrodes are at Right Angles to the Position Shown in Fig. 1

which it is attached has sufficient transformer capacity (not less than 20 kilowatts). The head is better adapted, however, to welding No. 18 gage stock or lighter.

In the accompanying illustration, the welding head is shown applied to a Federal spot-welding machine. It may be applied to any welder having a movable upper horn and a removable lower horn. The welding head with its electrode is clamped to the upper horn, while a second electrode is mounted on the lower horn. The welding head is driven by a motor mounted on a pedestal which has a gear-box at the upper end connected to the welding head through shafts and universal joints.

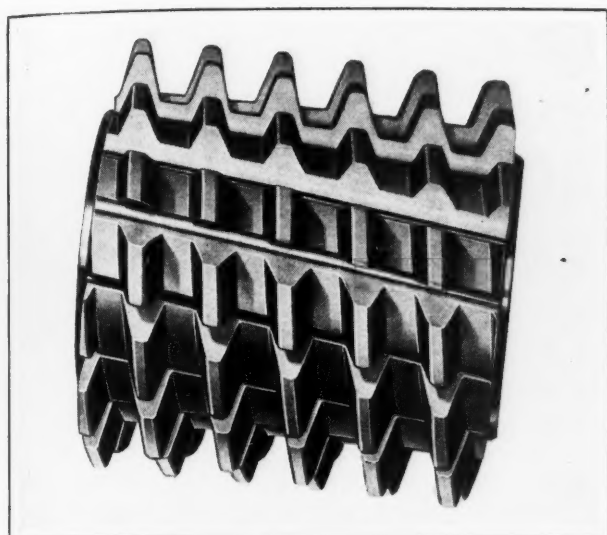
To enable side seams to be welded, the welding head can be readily swiveled 90 degrees in a horizontal plane from the position shown in Fig. 1 to that illustrated in Fig. 2, and a different style of lower electrode is then provided. The time required for making this change should not be more than ten minutes. The driving unit can also be conveniently shifted to suit the new position of the welding head, since it is never necessary to bolt the pedestal to the floor.

With the exception of a few small parts, this welding head is made of solid copper and bronze. Both electrodes and their shafts are water-cooled. The water enters each electrode shaft through a tube at one end and is delivered direct to the electrode by this tube. It returns on the outside of the tube and enters into a drip-cup, from which it flows to a waste pipe. The electrodes can be conveniently removed for dressing in a lathe, and spare electrodes can be used while the dressing is being done.

ILLINOIS SHEAR-CUT HOB

A shear-cut hob designed with a view to speeding up the roughing out of gear teeth has recently been produced by the Illinois Tool Works, 2505 N. Keeler Ave., Chicago, Ill. This tool is also adapted for simultaneously roughing and finishing gear teeth.

It will be noticed from the illustration that the gashes in this shear-cut hob are inclined back from the helix angle of the threads, instead of being normal to the threads, as is usual practice. In this shear-cut hob, the gashes are also under-cut. It will be apparent that certain changes in tooth form



Shear-cut Hob Made by the Illinois Tool Works

and lead have been necessitated by the design of this shear-cut hob; however, it is not within the scope of this article to discuss these points in detail.

Several advantages are obtained with the shear-cut hob, the first of which is a progressive cutting action by the tops of the hob teeth. One corner of each tooth comes into action first, and as the rotation of the hob continues, the remainder of the cutting edge at the top of each tooth comes gradually into action. This avoids the shock of having the entire top cutting edge of each tooth come in contact with the work at the same time. Also, by having the gashes under-cut, these top tooth edges have a "hook" which results in a sharper cutting edge. The same condition is obtained for the "leading" side edge of each tooth, through having the gashes inclined back from the helix angle of the threads.

The "leaving" side edges of the tooth have an obtuse angle that is less favorable for cutting than the angles of the "leading" and top edges, which are depended upon to do most of the work. It is claimed that as a result of the advantageous conditions provided for, the two areas of each tooth doing the bulk of the work, higher feeds can be employed and that under average conditions, a greater number of gears can be hobbled per grinding of the tool.

"PRODUCTO-MATIC" MILLING MACHINE OF INCREASED CAPACITY

The latest machine to be added to the line of "Producto-Matic" milling machines built by the Producto Machine Co., Bridgeport, Conn., successor to the Bilton Machine Tool Co., is known as the No. 50. In general construction and principle of operation, this machine closely follows the No. 45 machine which was previously the largest "Producto-Matic" built. However, the No. 50 machine has been made considerably heavier throughout, with the exception of the base, and the capacity has been increased a substantial amount. The base is the same as that provided on the No. 45 machine.

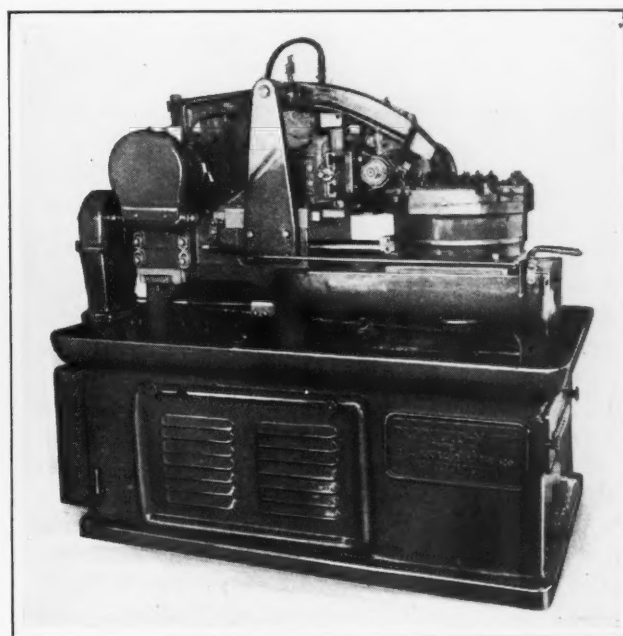
The stroke of the No. 50 machine is 6 inches, whereas that of the No. 45 was only 3 1/2 inches. The slide has been increased 9 3/4 inches in length, and the ram, 9 inches. The work turret or table is 21 inches in diameter as against 17 1/2 inches.

Heavier cams and a heavier camshaft are provided. The outboard support for the cutter-arbor is now furnished with a bearing that is adjustable for wear, and this support has a heavy slide to compensate for the longer movements of the main ram and slide.

One of the new features of the machine consists of a micrometer adjustment of the cross-rail on which the cutter-head is mounted. This permits of making close final adjustments of the cutters horizontally in relation to the work. The range of this adjustment is 1 1/4 inches. Work-holding fixtures of interchangeable construction may be provided to facilitate adapting the machine to different kinds of work.

An automatic clamping mechanism for gripping the work during the milling may be furnished as illustrated. This mechanism comprises a long curved fulcrum lever which extends from the camshaft at the rear of the machine to a position above the work-holding fixture. At the front end, the lever may be equipped with jaws, which are lowered on the work prior to the engagement of the cutters. This is accomplished by the action of a cam against a roller attached to the rear end of the lever. When the cutters recede from the work, the front end of the lever is raised to release the work, and the table then indexes to bring a new piece into position. The machine illustrated is arranged for milling four pieces of work simultaneously.

Similarly to previous "Producto-Matics," this new machine may be arranged for moving the cutters either horizontally or vertically across the work. Cams on the shaft at the rear of the machine, in addition to actuating the clamping mechanism as already described, impart the horizontal stroke to the cutter-head; give the vertical stroke to the cutter-head when desired; control the lock which holds the work-table in position during milling; and operate a plunger or rod to index the table. The operator merely loads and unloads the work in the stations of the table. Combined vertical and horizontal movements can be imparted to the cutter-head for milling angular or rounded parts.



"Producto-Matic" Milling Machine of Increased Capacity

The approximate weight of this machine is 7500 pounds, and the floor space occupied is 74 feet 44 inches. The machine is driven by a 7 1/2 horsepower motor.

FEDERAL MITER WELDING MACHINE

An automatic machine developed for butt-welding structural shapes along mitered edges to produce the corners of steel sashes, automobile doors, windshield trimming, etc., has been placed on the market by the Federal Machine & Welder Co., Dana Ave., Warren, Ohio. In this No. 60 machine, as illustrated in Fig. 2, the inside of the work pieces are supported on fixed steel dies, which are insulated. Movable copper dies, located on the outside of the work pieces, serve both as clamps and electrodes. The path of the current during the welding operation is as indicated by the arrows, with the result that the surfaces to be welded are subjected to a uniform flow of current, and consequently are evenly heated and welded. Another advantage of the method is that only a thin upset is produced, which can be easily chiseled away.

The movable dies are carried on hinged members having fulcrum points well beyond the flashing zone. The machine is inclined at an angle, so that



Fig. 1. Federal Butt-welder for Joining Mitered Ends of Structural Shapes

the work can be held in the horizontal plane while being welded. This feature is particularly desirable in welding long sashes.

The machine embodies the Federal "Flash Proof" principle. It is equipped with a 65-kilowatt transformer, and has a coil which provides 60 per cent voltage regulation. Clamping and releasing of the work, as well as starting of the motor, are controlled by means of foot-levers. A mechanical brake stops all motion at the end of the welding cycle.

The clamping is accomplished by air under a pressure of 80 pounds per square inch, acting in two cylinders. The flash and push-up operation is controlled by a cam which is motor-driven through a worm-gear reduction. An advantage of the motor-driven flash and push-up mechanism and the air-operated clamping devices is the relieving of the operator from all physical strain.

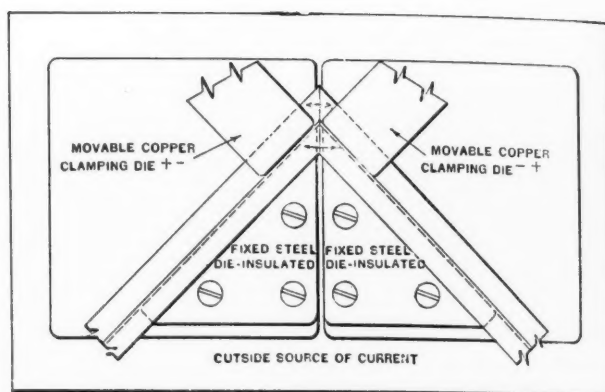


Fig. 2. Diagram Showing the Arrangement of the Copper and Steel Dies

The machine illustrated will weld structural shapes of cross-sections up to about 1 square inch, but it can be adapted to the welding of larger sections by increasing the transformer capacity. As geared, the machine consumes 7 seconds in the welding cycle, which, allowing time for clamping and releasing the work, results in an average welding speed of 240 welds per hour. The time varies with the kind of work and the jigs used for holding the work pieces.

GLEASON GRINDER FOR GENERATOR TOOLS

Tools used on any straight-bevel gear generator built by the Gleason Works, Rochester, N. Y., or on the 60-inch spiral-bevel gear planing generator, can be sharpened in a grinder recently developed by that concern. This machine is equipped with two grinding wheels, as illustrated. The upper tools are sharpened on one wheel, and the lower tools on the other. Grinding is always performed against the cutting edge of the tools, thus eliminating the possibility of burning the cutting edges.

Tools can be ground to any side rake angle by loosening the clamp on top of the tool-holder and turning the tool to the desired angle as marked on the collar. Any desired front rake angle can be obtained by making a similar setting at the point where the holder is attached. Adjustable weights on the tool-holders keep them away from the wheel in a convenient position for changing the work or settings. The work is pushed across the wheel by hand, and is fed in by means of a nut on the end of the shaft on which the tool-holders are mounted.

The grinding wheels are mounted on a spindle which

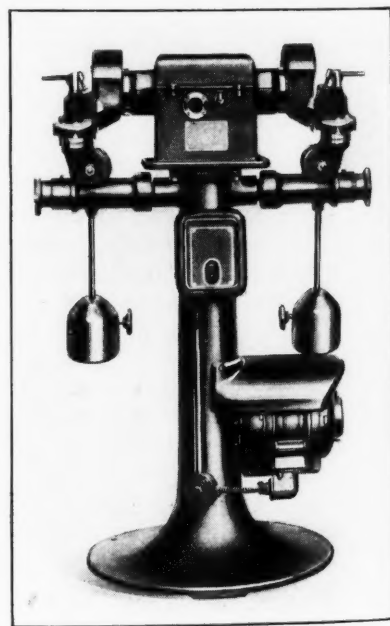


Fig. 1. Grinder for Sharpening Gleason Generator Tools

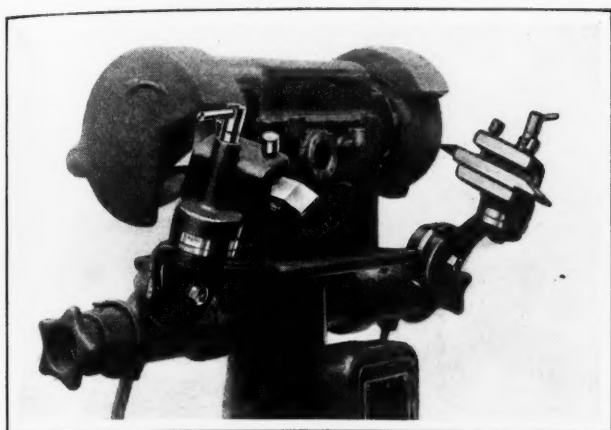


Fig. 2. View Showing Construction of Tool-holders

runs in oil and on ball bearings. The machine is simple in design, the only moving part of a belt-driven machine being the spindle on which the wheels are mounted. On motor-driven machines, power is transferred from the motor to the spindle by a belt which runs within the column. Standard machines are belt-driven, and are furnished with a belt guard.

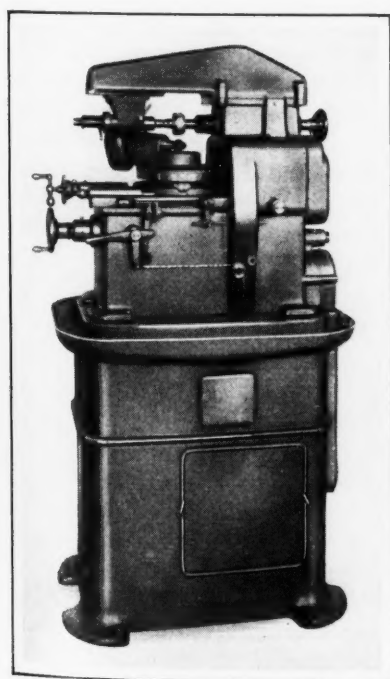
Three different pairs of tool-holders can be used, but only one pair is furnished as standard equipment. One pair holds tools for the 60-inch spiral-bevel gear planing generator; another pair holds tools for the 25-inch bevel-gear generator; and the third pair, tools for the older 6-, 11-, and 18-inch and the recent 12-inch bevel-gear generators and the 8-inch manufacturing bevel-gear generator. The machine weighs 375 pounds and occupies a floor space of 18 by 21 inches.

"MIKRON" UNIVERSAL GEAR-HOBGING MACHINE

A No. 102 "Mikron" automatic gear-hobbing machine designed for hobbing small spur and helical gears up to 5 1/4 inches in diameter and 5 1/2 inches in length is being introduced on the

American market by the Trip-lex Machine Tool Co., 50 Church St., New York City. This machine is intended for hobbing accurate gears for electric and water meters, clocks, watches, moving picture apparatus, phonographs, etc. It is regularly furnished with a countershaft, pump, oil reservoir, cabinet base in which tools may be stored, and tooling.

Gears having from 6 to 325



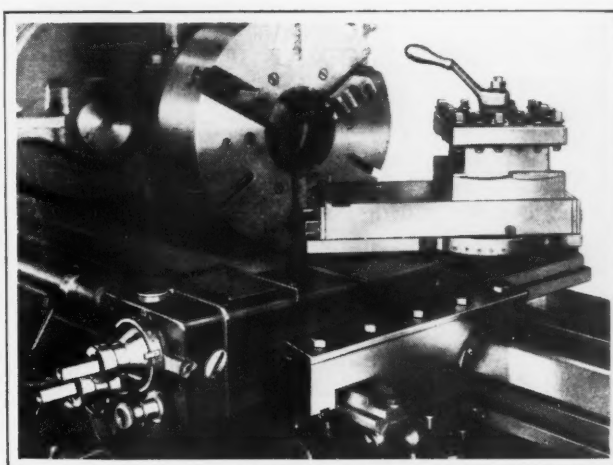
"Mikron" Gear-hobbing Machine

teeth, with spiral angles up to 70 degrees, either right- or left-hand, can be hobbed. Teeth as large as 12 diametral pitch can be cut. Change-gears are used for obtaining various divisions, and these gears are accessible by removing cover plates.

The work is held on an arbor for the operation. In practice, a spare arbor is used, so that one can be loaded while work on the other is being cut. A draw-in spindle is also provided to permit holding work in spring collets. The hob feed can be varied to suit the material being machined, change-gears providing a variation in feed of from 0.004 to 0.030 inch per revolution of the work.

The differential gearing is simple, being composed of spur gears on parallel spindles mounted in a cylinder. The worm-spindle is mounted eccentrically in the cylinder, this arrangement enabling all play between the division wheel and the worm to be eliminated with a slight rotation of the cylinder. The cutter swivel head can be rotated through an arc of 180 degrees.

By means of a special attachment, bevel gears up to 3 inches in diameter, having a bevel angle up to 180 degrees, can be hobbed. Bevel gear teeth as coarse as 20 diametral pitch can be cut. The approximate weight of the machine, with countershaft, is about 600 pounds, and the floor space occupied is about 2 by 3 feet.



Warner & Swasey Turret Lathe Equipped with New Compound Cross-slide

WARNER & SWASEY TURRET-LATHE COMPOUND CROSS-SLIDE

A compound cross-slide can now be furnished on the No. 3-A and 4-A turret lathes built by the Warner & Swasey Co., Cleveland, Ohio. This compound cross-slide can be used in turning bevel gear blanks and similar work having steep tapers, and can also be used for general work. The illustration shows the device in place on a turret lathe.

The square turret which carries the cutters is made from a solid forging, and the Warner & Swasey patented lock-bolt construction is used, so that it is not necessary to lift the turret off its seat for indexing. A swivel plate made from a steel casting is held to its base by four bolts. The cross-slide is attached to its base by a square lock construction, so that the slide, swivel plate, and square turret are rigid, even when the slide has traveled to the extreme end of its stroke and somewhat overhangs the base.

This compound cross-slide does not prevent the

full swing capacity of the turret lathes from being utilized. It may be used as a straight turning and facing slide, as well as a compound slide. By locating the four binding nuts underneath the swivel base rather than above, it has been possible to make the graduated dial on the compound base narrower than usual, thus giving less overhang to the cutters and eliminating interference with the chuck jaws.

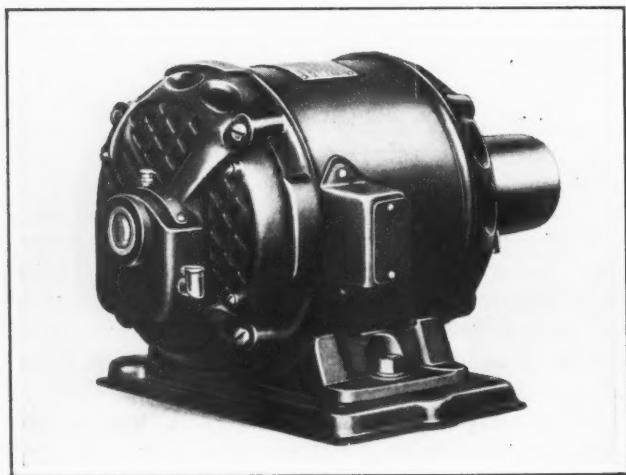
Angular surfaces can be faced or turned up to the full swing capacity of the turret lathes. The swivel plate can be rotated around the entire 360-degree circle, and the full swing stroke of the slide is 8 inches. It is possible to use the standard taper attachment with the compound cross-slide. Both the cross and compound slides have a power feed, the arrangement being such that it is impossible to engage both at the same time. A power feed knock-off is operated in the same manner as that on the standard cross-slide.

The feed mechanism is of the worm-gear type, a large worm-gear being mounted directly on a hardened and ground feed pinion shaft which has a bearing both above and below the worm-gear. Ball thrust bearings mounted on both sides of the feed worm are submerged in oil. With the rack and pinion construction employed, it is possible for the pinion to run entirely off its rack at either end of its stroke, which provides a safety feature.

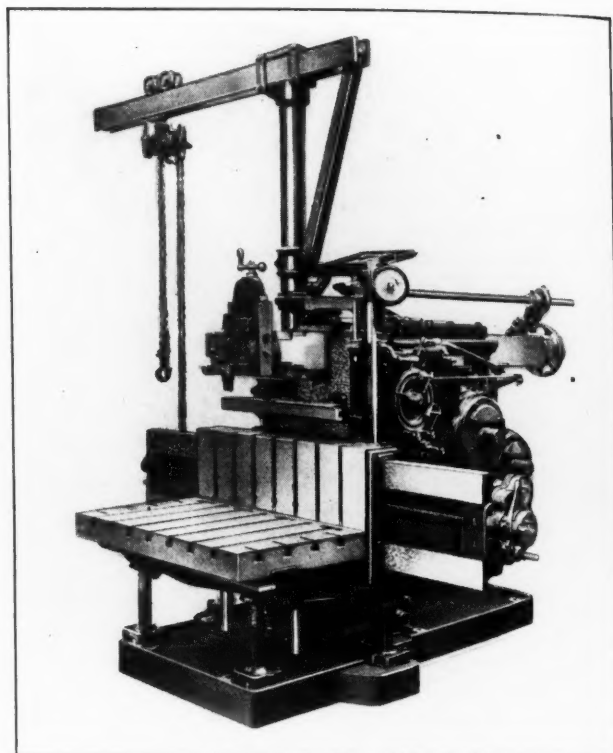
CENTURY DIRECT-CURRENT MOTORS

Direct-current motors in standard sizes, from 1/6 to 1/2 horsepower, are being placed on the market by the Century Electric Co., 1806 Pine St., St. Louis, Mo. These motors are built to run at speeds corresponding to the standard speeds of alternating-current motors. The field of the new motors is a two-pole laminated steel structure. The compound-wound field coils are wound on forms, well insulated and taped. The armature slots are insulated with alternate layers of fish paper and varnished cambric. Hardwood wedges retain the coils.

The commutator is made from rolled copper bars, and is insulated with mica. The brushes are carried in a box-type holder attached to the field frame, and do not require adjustment during their life. The system of lubrication employed assures at least one year's operation at twenty-four hours per day, without requiring reoiling.



Century Direct-current Motor



Morton Draw-cut Planer Designed Especially for Railroad Shop Work

MORTON HIGH-DUTY DRAW-CUT PLANER

A railroad-type draw-cut planer now being introduced to the trade by the Morton Mfg. Co., East Broadway and Hoyt St., Muskegon Heights, Mich., is designed especially for machining the frame fits in guide-yoke tie braces and cross-tie braces. It will also machine the guide fits on back cylinder-head blocks, locomotive deck castings, the casting units between cylinders, and other work within its range.

The machine has a cutting stroke of 38 inches, a horizontal or side feed of 60 inches, and a vertical feed of 21 inches. There is a rapid power traverse in both the horizontal and vertical directions. All feeds are automatic and can be changed while the machine is in operation.

The machine is of the four-screw type which makes possible the handling of large block castings. It is equipped with a rotating arbor for slotting and finishing driving-boxes, and it will accommodate all special Morton attachments designed for railroad work.

PALMER-BEE HERRINGBONE-GEAR SPEED REDUCERS

A complete line of speed reducers equipped with Sykes herringbone gears has recently been placed on the market by the Palmer-Bee Co., Detroit, Mich. The line includes reducers ranging in capacity from a fractional horsepower up to 200 horsepower, and in ratios from 2 to 1 up to 4000 to 1. The design of these reducers is such that the power is delivered on a straight line from the point of its inception. This feature facilitates mounting the complete drive on a common baseplate, and usually saves considerable floor space. It also involves the use of but one set of shafts for any desired reduction ratio.



Palmer-Bee Speed Reducer with Sykes Herringbone Gears

The mechanism operates in a dustproof oiltight housing of compact design. The lower halves of the bearings are cast integral with the frame to insure permanent alignment of shafts. The upper bearing halves are formed in removable caps, which are held in place by studs. With this construction, the removal of the upper half of the housing does not affect the alignment or fit of the bearings to the shafts. The housing of a given size of reducer accommodates gearing for all the ratios, so that the ratio may be increased or decreased at any time by substituting one or more pairs of gears, all parts being made interchangeable.

Lubrication of these reducers is accomplished by means of a combined oil-bath, splash and gravity-feed system which floods the entire mechanism and bearings with oil. A single oiling suffices for 1000 hours of normal service without replenishment. There are no external means of lubrication, such as grease or oil cups.

These reducers can be furnished with standard shaft projections for direct connection to the motor and the driven machine, or with extended high- or low-speed shafts when the power is transmitted either to or from the reducer by means of a chain, belt, or exposed gears. Complete speed reducer drives can be supplied, including any style of electric motor, flexible couplings, outboard bearings, and sub-bases.

GENERAL ELECTRIC DRUM SWITCHES

A new line of primary-resistance drum switches designed for use with squirrel-cage induction motors on machine tools, small cranes, hoists, etc., is being introduced to the trade by the General Electric Co., Schenectady, N. Y. These CR-3200-1250 switches are designed for wall mounting and can be furnished with a standard conduit box. The switches are made in two forms, one for hoists where the motor is overhauled in the lowering direction, and the other for hoists where the motor is not overhauled in the lowering direction.

The switches are built without an operating mechanism, so that the user may select that type of operating equipment which he desires. They are designed for operation on maximum primary voltages of 550, and 15 horsepower is the maximum rating for two- or three-phase current.

ROTARY CHUCK FOR PRATT & WHITNEY VERTICAL SURFACE GRINDER

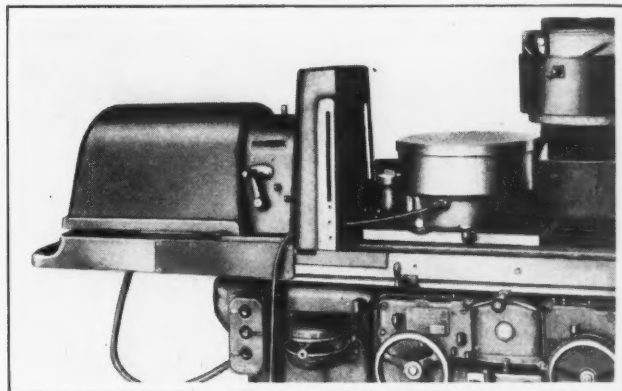
A separately driven rotary chuck designed for use with the model B 14-inch vertical surface grinder built by the Pratt & Whitney Co., Hartford, Conn., has recently been developed by this concern. The machine itself was described in March, 1926, *MACHINERY*. The new rotary chuck is a self-contained unit, mounted on the left-hand end of the table, as illustrated. It may be of either a plain or magnetic type.

This chuck is driven by a two-horsepower motor, mounted on the same end of the table, the motor driving through a two-speed gear-box, spiral-bevel gears and worm-gearing. The gear-box, operated by a lever on the front, gives speeds of 108 and 154 revolutions per minute. The motor is provided with a push-button control, including a jog button.

With the machine table in the extreme left-hand position, the chuck is fully accessible for loading. By using the regular power table traverse, it can then be moved under the wheel and stopped in any desired position for the grinding operation. The chuck is finally moved from under the wheel under power in the same manner. If desired, a special device can be furnished to automatically locate the rotary chuck under the wheel in the desired grinding position.

The plain chuck has its top surface finished smooth to receive fixtures, and may be tapped to suit. The new magnetic chuck has greater holding power than previous models. Either type of chuck may be tilted 1 1/2 degrees above or 5 degrees below the horizontal, to provide for grinding a wide range of concave and convex surfaces. Lubrication is supplied to all moving parts, except the motor, from three reservoirs.

The motor runs at 1200 revolutions per minute, and may be furnished for either alternating or direct current. Electrical braking is provided in order to stop the chuck quickly when the power is turned off. The diameter of this new chuck is 16 inches. The distance from the chuck surface



Pratt & Whitney Vertical Surface Grinder Equipped with New Rotary Chuck

to a new wheel is regularly 7 1/4 inches for the plain chuck, and 4 inches for the magnetic chuck, but this distance can be changed by means of raising blocks.

REED-PRENTICE GEARED-HEAD LATHE

Eight spindle speeds, ranging in geometrical progression from 18 to 432 revolutions per minute, are obtainable through nine gears, in 14- and 16-inch lathes equipped with sliding gears in the headstock, which are being placed on the market by the Reed-Prentice Corporation, Worcester, Mass. These speed changes are made by operating three levers on the front of the headstock. The headstock gears are made of nickel-chromium steel, and are hardened in electric furnaces by the Hump method. The teeth are burnished before hardening, and are lapped afterward. The back-shafts are also made of heat-treated steel, and run in ball bearings. Sliding gears are mounted on six-spline shafts, and are machined to engage smoothly and quickly. All gears run in a bath of oil.

The spindle is made of heat-treated nickel-chromium steel, and runs in four Timken tapered roller bearings, as shown in Fig. 3. Thrust loads are taken by the front bearings. A "Twin Disc" clutch and brake in the main pulley provide for instant starting and stopping of the spindle. This unit is controlled by levers on the quick-change gear-box

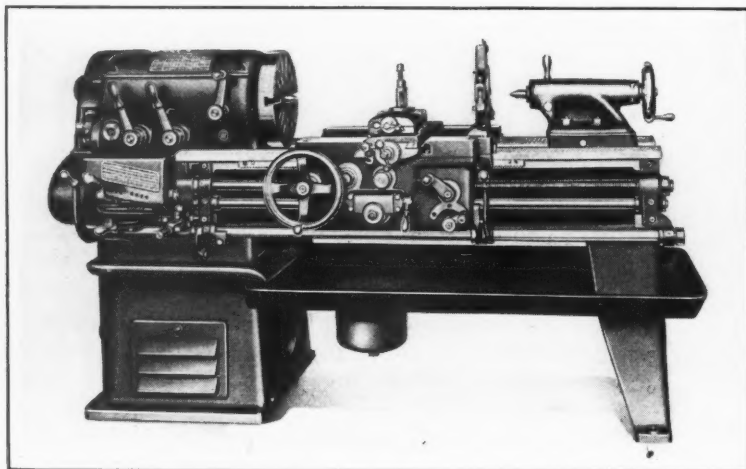


Fig. 1. Reed-Prentice Engine Lathe with Selective-speed Geared Head

and on the apron. There is only one point of adjustment on the clutch, which is easily accessible.

Forty-one changes of feeds and threads are obtainable through the quick-change gear-box, which is provided with gears made of a high manganese steel. The feeds range from 0.0035 to 0.112 inch per spindle revolution, while the range of threads which can be cut is from 3 to 96 per inch, inclusive. End gearing provides for the cutting of threads of special pitches.

The apron is a one-piece casting of the double-support type. It is equipped with a double disk clutch for controlling the cross and longitudinal feeds by means of one lever. The cross-feed screw is made of chrome-vanadium steel, and is furnished with a two-way ball thrust

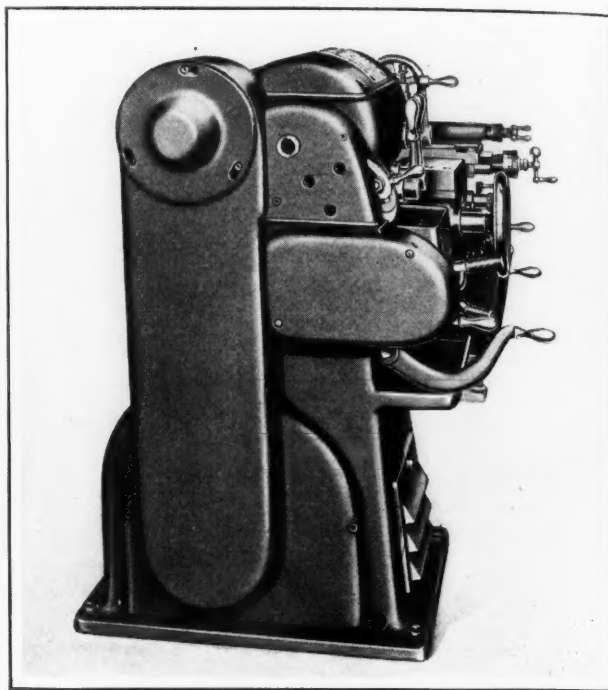


Fig. 2. Head End of the Reed-Prentice Lathe

bearing. The apron has a central oil reservoir. The lead-screw is mounted in radial ball bearings, and is also provided with hardened steel and bronze washers for taking up end thrust.

A self-contained motor drive is provided through a motor mounted within the cabinet leg on a hinged bracket which is adjustable through a screw and nut. Power can be delivered from the motor to the machine through a belt or chain. The actual swing over the compound rest and bed of the 14-inch lathe is 9 and 14 1/2 inches, respectively, and of the 16-inch lathe, 11 and 16 1/2 inches, respectively. The maximum distance between centers with a 6-foot bed is 31 1/2 inches; diameter of hole through spindle, 1 1/4 inches; diameter of driving pulley, 10 inches; width of driving belt, 3 inches; speed of driving pulley, 450 revolutions per minute; and size of motor, 3 horsepower. The 14-inch lathe, with standard equipment, weighs 2450 pounds, and the 16-inch lathe, 2675 pounds.

JAMES HERRINGBONE-GEAR SPEED REDUCERS

Continuous-tooth herringbone-gear speed reducers made by the D. O. James Mfg. Co., 1120 W.

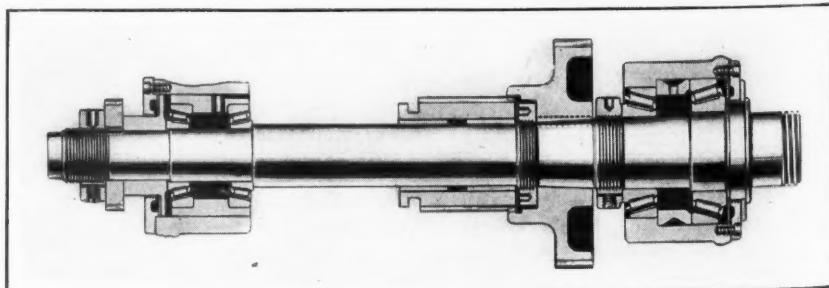
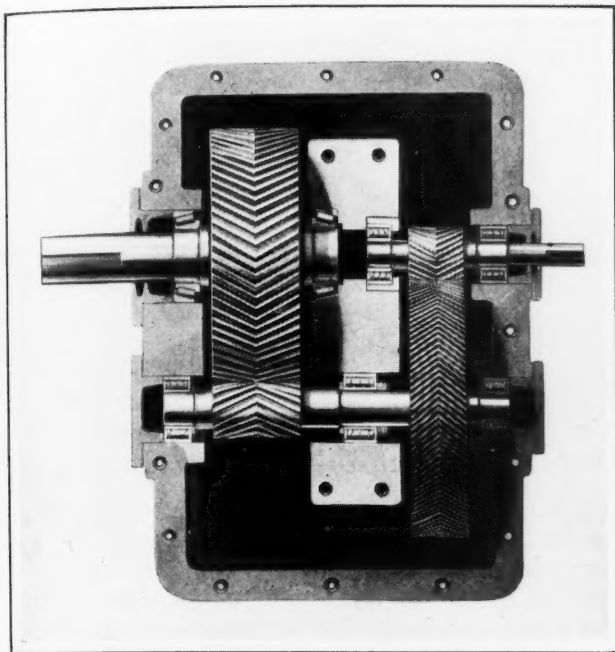


Fig. 3. Illustration Showing the Mounting of the Lathe Spindle in Timken Tapered Roller Bearings



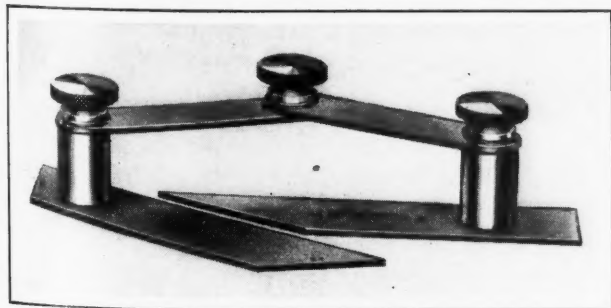
James Speed Reducer with Hyatt and Timken Bearings

Monroe St., Chicago, Ill., have been improved by the application of roller bearings for the various shafts. The double-type reducer here illustrated is equipped with Hyatt roller bearings on the high-, intermediate- and slow-speed pinion shafts, and with Timken tapered roller bearings on the slow-speed gear shaft. The single-type herringbone-gear speed reducer is equipped with Timken tapered roller bearings on both shafts.

BROWN & SHARPE COMBINATION BEVEL

The improved combination bevel No. 502 here illustrated has recently been added to the products of the Brown & Sharpe Mfg. Co., Providence, R. I. A feature of this new tool is the provision of two posts, which permit an unobstructed view of the blades, regardless of the angle at which the blades are set. These posts give clearance to permit scribing or drawing lines the full length of the blades. Also, they make possible the use of the blades on alternate sides of a projection up to 7/8 inch high.

The back of the tool is flat, so that it may be laid directly on the work. The clamp nuts are so designed that the blades can be moved freely without looseness and locked securely by tightening the



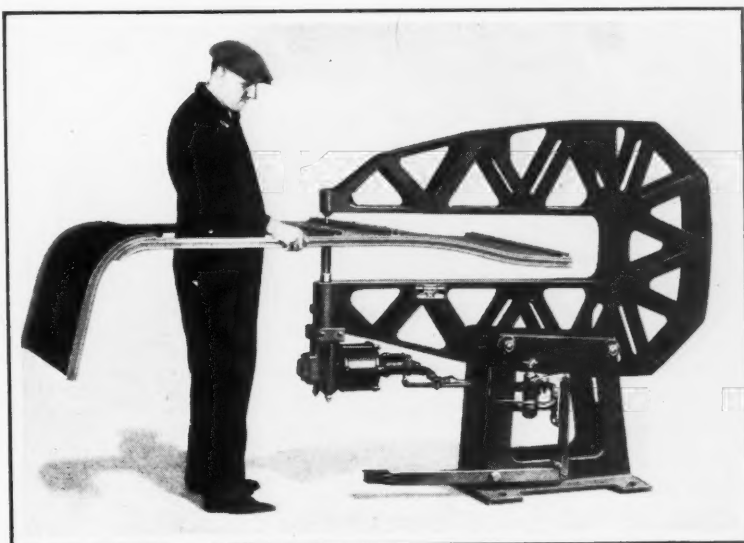
Brown & Sharpe Combination Bevel, Adjustable to Any Angle

nuts. The blades are ground on all sides, and their ends are ground accurately to angles of 30, 45, 60, and 90 degrees. The blades are made of steel, while the posts are made of light metal to decrease the weight of the tool.

HANNA RIVETER FOR "DURALUMIN" RIVETS

The ever-increasing use of "Duralumin" rivets in aircraft and motor-coach body construction has led the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill., to develop the riveter here illustrated. This equipment has a 48-inch reach, a 10-inch gap, a 1 1/2-inch die stroke and, when operated at an air pressure of 100 pounds per square inch, is capable of driving 1/4-inch "Duralumin" rivets. It has a possible ram speed of 60 strokes per minute.

The pressure exerted by the ram is predetermined. A uniform pressure is exerted for a considerable portion of the ram stroke, which results in properly driven rivets, regardless of variations in the thickness of the parts being riveted. With the dies in a vertical position and the cylinder down, as shown in the illustration, rivets can be headed on the under side.



Hanna Riveter Designed Primarily for Driving "Duralumin" Rivets

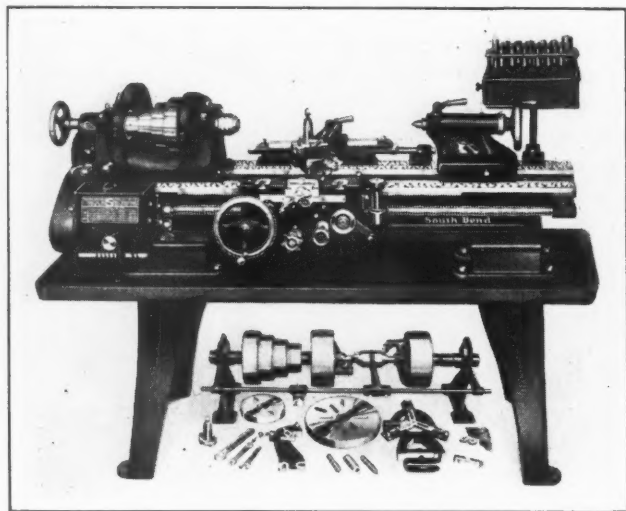
Rivets may be inserted well in advance of the riveting, and so interruptions for the insertion of rivets are reduced to a minimum, with the result that the operation becomes almost a continuous one. The riveter is operated by means of a foot-actuated valve. With this arrangement, the operator's hands are free to handle the work. This equipment is built in a wide range of sizes for either portable or stationary use.

SOUTH BEND TOOL-ROOM LATHE

A 13-inch by 5-foot precision tool-room lathe is the latest addition to the products of the South Bend Lathe Works, 786 E. Madison St., South Bend, Ind. This lathe is back-geared and gives eight spindle speeds, four of which are obtained direct through the belt and the other four through the back-gears.

Among the special attachments for use on this lathe is a handwheel draw-in collet chuck, which may be employed extensively in the production of small parts, as well as in general tool-room work. Round, square, and hexagonal collets may be used in this chuck, the collets making the attachment adaptable to tubing or bar stock up to 5/8 inch in diameter. The headstock spindle is hollow and allows tubing, rods, or bars up to 1 inch in diameter to be passed through it. Other attachments include a taper attachment, thread dial, micrometer carriage stop, oil-pan, and collet cabinet and bracket.

The carriage has power longitudinal and power cross feeds, which are obtained through a splined lead-screw and worm in the lathe apron, independently of the lead-screw thread. Instant changing of the lead-screw direction for cutting right- or left-hand threads or for feeding a tool in either direction across the work is obtained by means of



South Bend Tool-room Lathe

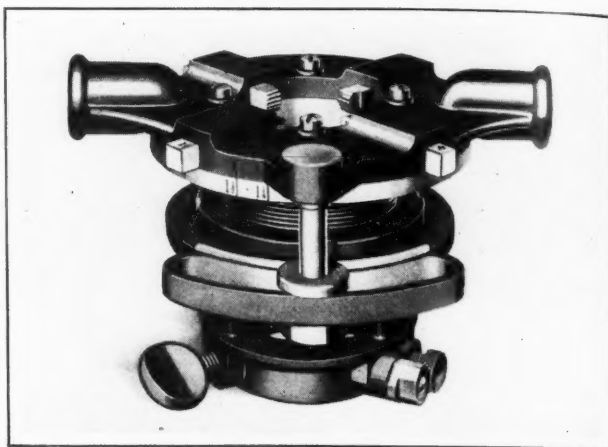
a quick-acting latch reverse lever. In addition to an overhead countershaft drive, three types of direct motor drive may be provided for this lathe.

"BEAVER" DIE-STOCKS

Two self-contained and adjustable 1- to 2-inch die-stocks, known as the No. 11 plain and the No. 11-A ratchet, have been added to the line of "Beaver" die-stocks manufactured by the Borden Co., Warren, Ohio. The first mentioned of these die-stocks supersedes the No. 25 plain type, while the No. 11-A, supersedes the No. 26 ratchet type. The new die-stocks are lighter in weight, easier working, and simpler in construction.

One set of dies can be quickly set in these new die-stocks to cut 1-, 1 1/4-, 1 1/2-, or 2-inch threads. The dies cannot become lost or mislaid, because they are always in the tool ready for use. They can be quickly adjusted for threading under or over standard sizes, without affecting the thread length. Brass pipe can be threaded without the necessity of using special dies.

The die-head and the threaded barrel are separate parts, so that when repairs are required, only one part need be bought. The work-holder, or pipe-gripping device, is of a new design which centers



"Beaver" Die-stock Recently Brought out by the Borden Co.

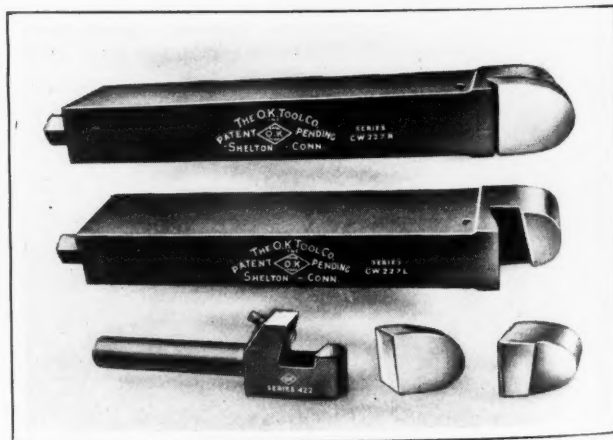
the pipe accurately. Two knurled screws, which firmly hold to the pipe size, are quickly set, and after the die-stock has been placed on a pipe, it is only necessary to tighten a thumb-screw. After the work-holder has been set to size, only a straight thread can be cut, but it may be quickly adjusted to permit cutting crooked or drip threads when desired. It will also grip any size of coupling for threading short nipples.

O. K. TOOL CO.'S WHEEL TURNING TOOLS AND HOLDERS

Tool bits and holders designed primarily for the severe service met with in turning car wheels and tires, particularly after these parts have become worn and pounded in use, are being introduced to the trade by the O. K. Tool Co., Inc., Shelton, Conn. These tool bits are shankless, being retained in the holders by a double-taper construction, which is really self-locking in the direction of the feed; however, the usual rear lock arrangement is used in the holders.

The tool bits may be adjusted sidewise for wear in the direction of the feed by merely moving the lock to make the bit project further from the side of the holder. Since holes are not required in the holders for tool-bit shanks, the holders are strengthened considerably. The tool bits may easily be changed and reground in the separate hand-holder seen at the bottom of the illustration.

The tool bits are drop-forged of high-speed steel and heat-treated, while the holders are forged of



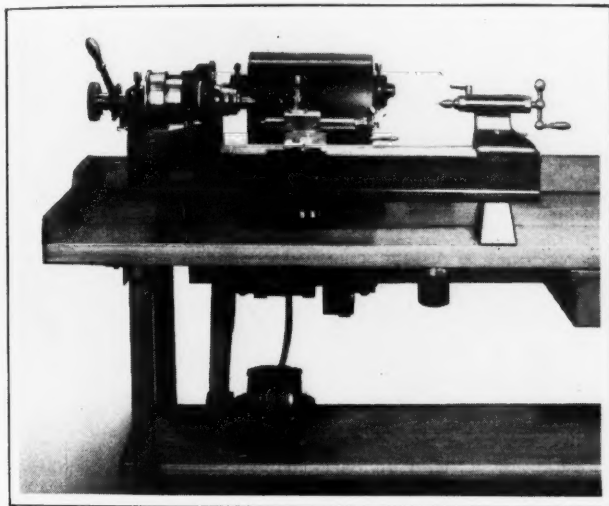
Car-wheel Turning Tool Bits, Holders, and Grinding Holder Made by the O. K. Tool Co., Inc.

chrome-nickel steel and also heat-treated. Although these tool bits and holders are primarily designed for wheel truing, they may be furnished in various shapes and sizes for other operations.

RIVETT BENCH LATHE HORIZONTAL SAFETY DRIVE

Bench lathes made by the Rivett Lathe & Grinder Corporation, Brighton, Boston, Mass., may now be provided with the "horizontal safety drive" here illustrated, which obviates the necessity of mounting a countershaft in the usual overhead position on uprights. This driving unit is assembled to a base which has countershaft brackets bolted to it. The base is mounted on a fulcrum rod extending through the sides of the heavy cast-iron bench guard or box.

A rod carrying adjusting nuts, which bear against the front face of the bench guard, provides



Rivett Bench Lathe Arranged with Horizontal Safety Drive

a means for drawing forward the lower edge of the countershaft base and, consequently, swinging back the upper part of the base which carries the countershaft brackets. This swinging back of the countershaft tightens the horizontal belt which drives the lathe headstock and also tightens the vertical belts running from the motor jack-shaft mounted under the bench.

When tension adjustment has been accomplished by the tightening rod, a nut on the end of the fulcrum rod is tightened to clamp the sides of the bench guard against the countershaft base, which gives a rigid countershaft mounting. A sheet-iron guard (not shown in the illustration) extends from the front edge of a guard over the countershaft pulleys and belts, and is attached to the countershaft base.

The advantages claimed for this drive are that countershaft vibration is eliminated, that savings are obtained in the length of belts, and that the danger from breaking belts is removed. The adjustment feature permits the use of endless belts. Better light is also obtained by substituting this arrangement in place of overhead belts. The drive gives the required speeds with the smoothness desirable in precision work. It is fully covered in patent applications. The motor jack-shaft is also of a new and simplified design.



Work-bench Made by the Angle Steel Stool Co.

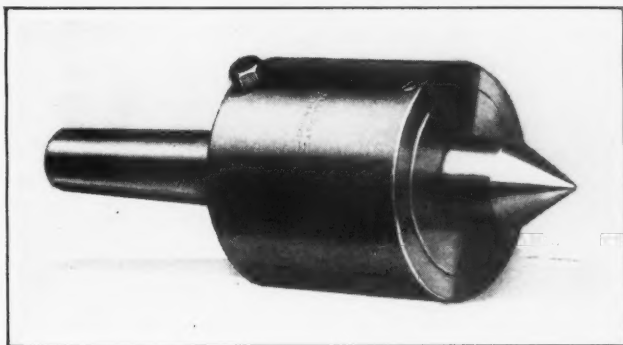
ALL-STEEL WORK-BENCHES

Work-benches built completely of steel, as illustrated, have been added to the line of steel equipment manufactured by the Angle Steel Stool Co., Plainwell, Mich. These benches are furnished in 4-, 5- and 6-foot widths; in 24- and 30-inch depths from front to back; and in 30-, 32-, 34- and 36-inch heights. The benches may be obtained with or without the raised back and side edges above the top. The shelf and drawer are also optional.

The bench legs are so arranged that a long section of benches may be constructed as a unit. For instance, a bench extending 18 feet along a wall could be built up of three 6-foot units. All surfaces are finished with an olive green lacquer, which protects the steel from rust and deterioration.

SNELLEX ANTI-FRICTION CENTER

A "Super" center has been added to the line of anti-friction centers made by the Snellex Mfg. Co., Rochester, N. Y. This center can be furnished for carrying loads up to 3 tons. It is provided with a hardened steel cushion, which automatically compensates for expansion of the work. It does not require lubrication on the center point, because two tapered roller bearings eliminate wear between the point and the work. Wear and play of the tapered roller bearings are automatically taken up. Lubrication is supplied to the bearings through an oil-hole, a strainer at the bottom of the oil-hole preventing solids in the oil from reaching the internal parts of the center. The shank can be made to any taper, and any type of center point can be furnished to suit the turning of car axles, crankshafts, gears, and other work.



Snellex Anti-friction Center Made for Loads up to Three Tons

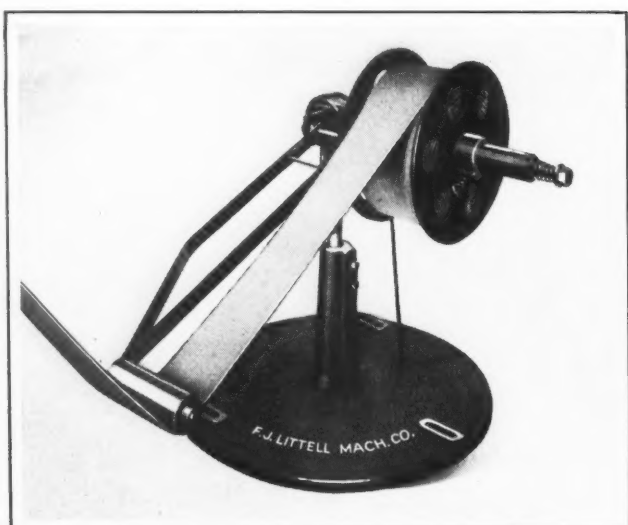


Fig. 1. Littell Stock Reel with Automatic Brake

LITTELL STOCK-FEEDING REELS

Four new reels have been designed by the F. J. Littell Machine Co., 4125 Ravenswood Ave., Chicago, Ill., for feeding coil stock to punch presses. The No. 1 reel illustrated in Fig. 1 is equipped with an automatic brake and is especially designed to prevent over-runs. The roller rides on the stock while it is being fed, but as soon as the feed stops, the brake pushes the roller down on the stock.

The reel shown at the left in Fig. 2 is primarily designed for heavy coils. This No. 2 reel will easily take stock up to 8 inches wide, and stock up to 12 inches in width, or even wider, can be accommodated. The base is designed in such a way that tipping is prevented. At the right in Fig. 2 is shown a No. 1 cage-type reel, which is intended for use with coils of spring steel, phosphor-bronze, and similar metals. This reel does not revolve, the coil revolving within the reel and over the rollers on the reel arms.

A No. 1 1/2 ball-bearing reel with plates, somewhat similar in design to that illustrated in Fig. 1, but which is not equipped with a brake, is made for very wide stock. This reel will take stock up to 16 1/2 inches wide, and is particularly suitable for coils having small holes.

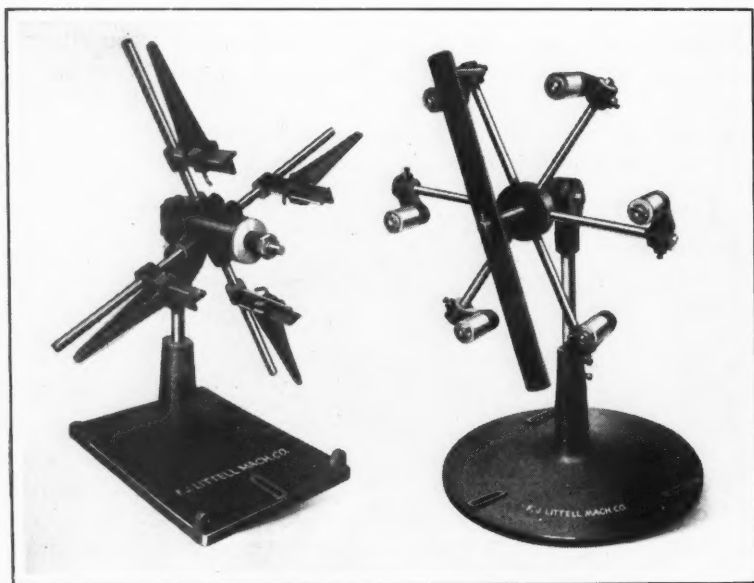


Fig. 2. Two Additional Littell Stock-feeding Reels

BIAX MULTI-PURPOSE FLEXIBLE-SHAFT UNIT

The speeds of a universal flexible-shaft unit recently placed on the market by the Biax Flexible Shaft Co., Inc., 20 E. Seventeenth St., New York City, may be varied to suit the requirements of different operations. The obtainable speeds are 850 revolutions per minute for rotary files; 2200 revolutions per minute for elastic sanding wheels, disks, polishing heads, and steel-wire brushes; and 4500 revolutions per minute for small sanding and grinding wheels more than 2 inches in diameter. For grinding wheels smaller than 2 inches in diameter, profile-type pencil stones, and felt polishing heads, a speed of 11,000 revolutions per minute is obtainable by means of a high-speed gear unit which is interchangeable with the hand-pieces of the flexible shaft.



Fig. 1. Biax Flexible-shaft Unit

Changing the belt to the different pulleys to obtain the various speeds is facilitated by means of an eccentric in which the ball-bearing transmission shaft is mounted. By merely moving a handle along a ratchet, this eccentric can be revolved and the position of the pulleys shifted sufficiently to permit quick changing of the belt to any set of pulleys. When the belt has been shifted, the eccentric is readily returned into the working position, where it is automatically locked in place.

Attachment and detachment of the various hand-pieces are facilitated by a simple ball-bearing jaw connection. Another feature of this connection is that it permits the swiveling of hand-pieces 360 degrees without imposing stresses on the shaft or casing. The motor and countershaft are mounted to swivel both vertically and horizontally, which increases the flexibility of the machine.

Fig. 2 shows some of the tools made for

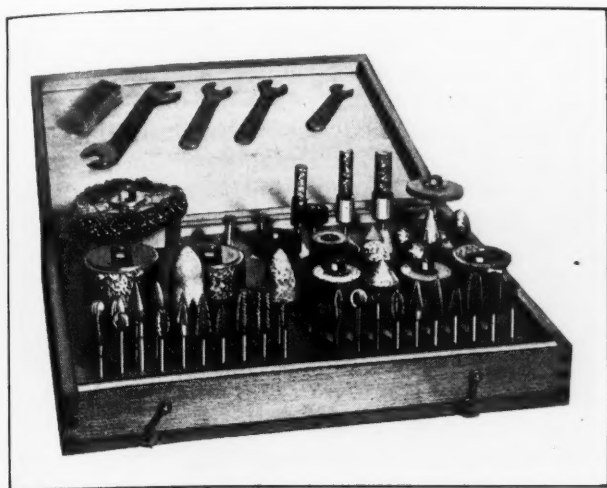


Fig. 2. Various Tools Made for Use with the Biax Unit

use with this unit. They include files of various shapes and sizes, profile- and straight-form grinding wheels, elastic sanding wheels, polishing heads, and brushes. A special hand-piece without springs can be furnished to give the tool-holder a short stroke. Files of square, round, half-round, or other profiles can be used in this hand-piece.

To permit the convenient dressing of emery wheels and pencil stones, the base of the machine is equipped with a holder in which the hand-piece may be gripped while tools are being dressed. In addition to the bench-type machine illustrated, a floor-type unit is also being introduced to the trade at this time.

LARSON STRAIGHT-LINE POLISHING MACHINE

A Larson automatic machine designed primarily for polishing large flat-surface articles, such as bumper bars, molding strips, T-squares, etc., is being placed on the market by the Hanson-Van Winkle-Munning Co., Matawan, N. J. This machine also lends itself to special polishing and buffing operations through the use of lifting cams for irregular shapes; positive rotating fixtures for circular work, such as automobile lamps; and automatic spinning fixtures for bolt heads or vanity cases. It is stated that almost any hand operation can be duplicated, due to the flexibility of the spindle adjustment and the construction of the work platens.

A feature of the machine is the carrier table, which consists of a series of cast-iron platens that interlock to form a solid table on which the work is set. These platens are mounted on adjustable hardened rollers, which run on a track to maintain the platen tops at a constant level. Fixtures or magnetic chucks for holding the work may be fastened to the platens.

The polishing wheels are mounted on spindles running in double bearings, which, in turn, are

mounted on yokes controlled by compensating springs. The spindles are adjustable to any pressure, and oscillate over the work. If desired, the oscillating motion may be eliminated on the last spindle to straighten the high-light marks. For all cutting operations, the polishing wheels spin opposite to the direction in which the work moves, but for the final finish, the last wheel may be rotated in the same direction as that in which the work moves. The spindle yokes and wheels may be set at various angles, so that each succeeding wheel will polish or buff out the marks left by the preceding wheel.

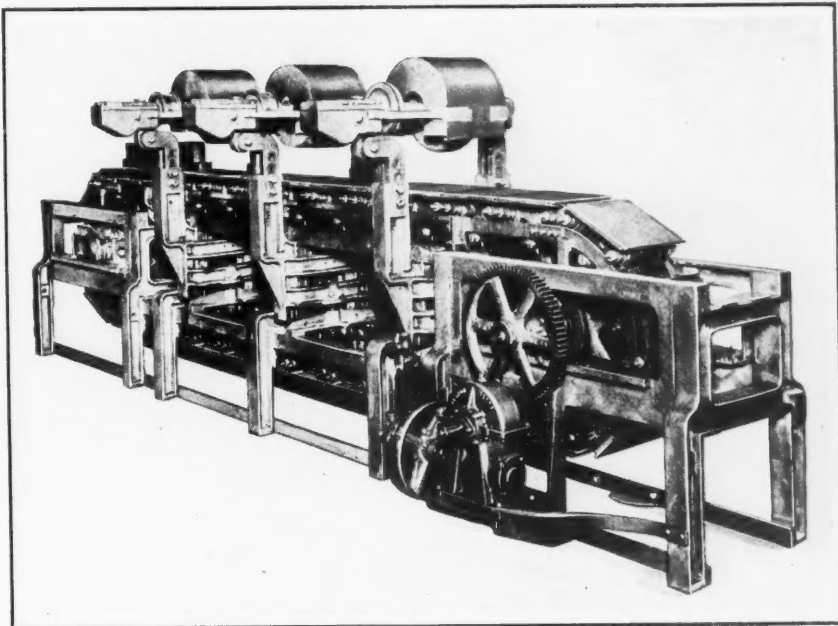
Any number of polishing wheels can be used, as the machine is built on a sectional basis. The movement of the table is controlled by foot-levers placed at both the delivery and receiving ends. The table may be brought quickly to a dead stop by exerting pressure on the foot clutch. When the table is started, the spindle heads automatically lower the polishing wheels to the work, and when the table is stopped the wheels are automatically lifted.

The polishing wheel spindles may be driven by a motor or from an overhead countershaft. A "Texrope" drive can also be furnished. The platens travel normally at a speed of 12 feet per minute, but the speed can be altered to suit conditions. The machine illustrated occupies a floor space of 3 1/2 by 14 feet and weighs approximately 4500 pounds, exclusive of motor, magnetic chuck, or attachments for special jobs.

APEX VERTICAL-FLOAT FRICTION CHUCK

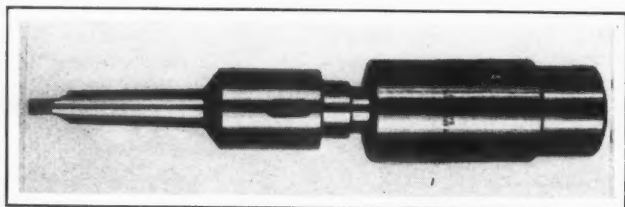
A vertical-float friction chuck, primarily designed for use in the multiple tapping of holes in tough metals, has been added to the line of drilling and tapping chucks manufactured by the Apex Machine Co., 303 Davis Ave., Dayton, Ohio. If one tap sticks or strikes the bottom in a multiple operation, the friction unit of the chuck will slip and the float will take care of the spindle travel.

This chuck employs the same quick-change collets as are used in the other types of Apex tapping



Larson Polishing Machine Built with Any Number of Polishing Wheels

chucks, the taps being free to float in these collets. The friction unit is also the same as that used in the standard friction chuck manufactured by the concern. It consists of a multiple disk clutch which, when adjusted, will maintain its setting over a period of weeks. Thrust of the spindle does not affect the friction unit. This chuck is made in two sizes, the type MA having a capacity for 3/8-inch

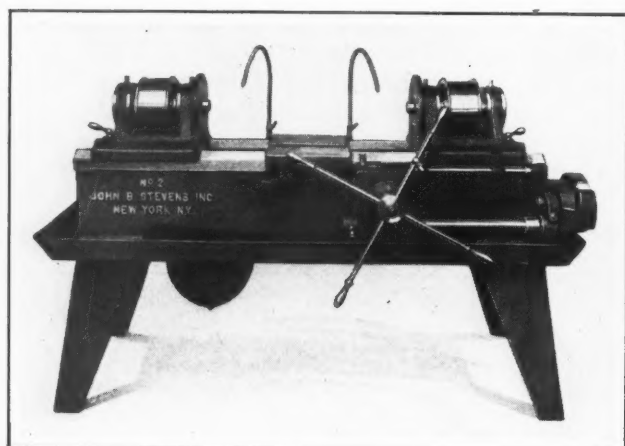


Apex Friction Chuck Designed for Use in Multiple Tapping Operations

taps and being 1 5/16 inches in outside diameter, while the type MB chuck has a capacity for 3/4-inch taps and has an outside diameter of 1 7/8 inches.

STEVENS HORIZONTAL DRILLING MACHINE

A No. 2 "Duple" horizontal machine intended for drilling, boring, beveling, chamfering, reaming, and facing operations, as well as for some classes of threading and tapping, was recently brought out by John B. Stevens, Inc., 27 Cleveland Place, New York City. Plain or back-gear heads may be provided on this machine. The heads are driven through two countershafts, one for each head. The spindles revolve in large ball bearings which take both radial and thrust loads.



Stevens Horizontal Drilling Machine with Two Opposed Heads

The two heads are fed toward the fixture table by means of 1 1/2-inch diameter square-thread screws beneath them. These screws are driven through a cross-shaft and spiral bevel gears. The front end of the cross-shaft carries a large bronze worm-gear, which is driven by a hardened steel worm on the shaft that extends toward the right along the front side of the bed. This shaft is driven through gears by a pulley which receives power from the right-hand countershaft. Ball bearings are provided throughout for the various shafts.

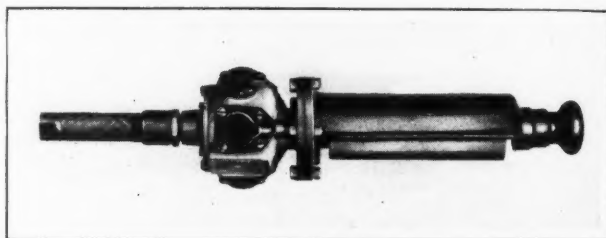
Four change-gears furnish three different feed changes, which are 0.003, 0.0065, and 0.014 inch per spindle revolution for the plain heads, and

0.0045, 0.0105 and 0.014 inch per spindle revolution for the back-gear heads. Hand and automatic trips are furnished for the feeding movement, and there is a positive stop.

The plain heads have a maximum drilling capacity in cast iron of 1 1/8 inches; in steel, 7/8 inch; and in cored holes, 1 5/8 inches; while the back-gear heads have a maximum drilling capacity in cast iron of 1 1/2 inches; in steel, 1 1/8 inches; and in cored holes, 2 1/4 inches. The machine occupies a floor space of 80 by 24 inches.

INGERSOLL-RAND LOCOMOTIVE ROD GRINDER

The portable pneumatic grinder here illustrated has been developed by the Ingersoll-Rand Co., 11 Broadway, New York City, primarily for polishing locomotive side, main, and valve-motion rods. This size 63 tool takes a 2 1/2-inch diameter, 6-inch wide grinding wheel, and has an outboard bearing and hand grip. Its light construction and wide-faced wheel make it suitable for grinding many



Ingersoll-Rand Portable Pneumatic Grinder with Wide-faced Wheel

other wide surfaces. In addition to those mentioned, other applications in the railroad shop include such operations as grinding welds on side rods, grinding brasses to fit main rods, grinding the jaws in main rods to smooth them up for new brasses, grinding the relief on brasses after they have been fitted to rods, grinding the frame jaws for reseating wedges, and grinding holes in the frame for refitting brake pins.

The construction of this grinder is similar to that of other Ingersoll-Rand portable grinders. The motor has three cylinders which are spaced about the center line of the spindle, all of which deliver power to one crankpin. Each of the three cast-iron cylinders is separate from the aluminum case. All are interchangeable and readily removed.

The weight of the tool, with a grinding wheel, is 16 1/4 pounds, and the average free speed is 6000 revolutions per minute. The length over-all is 23 1/4 inches.

BROWN & SHARPE SPIRAL SHELL END-MILLS

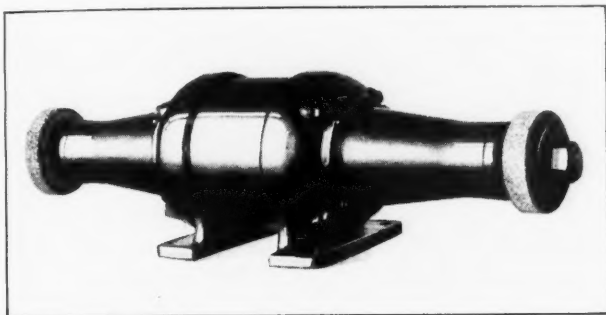
A new line of high-speed steel spiral shell end-mills is being introduced to the trade by the Brown & Sharpe Mfg. Co., Providence, R. I. These mills are stocked in fourteen sizes ranging in diameter from 1 1/4 to 6 inches. Arbors can be furnished to adapt these cutters for use on Brown & Sharpe milling machines having threaded- or taper-nose spindles and for all milling machines having the standardized spindle end. The mills are made in left- and right-hand styles.

FORBES & MYERS HIGH-FREQUENCY GRINDERS

Several high-frequency grinders from 1/4 to 2 horsepower in capacity, designed for speeds of from 5400 to 10,800 revolutions per minute, have been added to the line of grinders made by Forbes & Myers, 172 Union St., Worcester, Mass. These grinders are intended for wheels from 1 to 5 inches in diameter. The illustration shows the model 204, which runs at 5400 revolutions per minute, is of double-end design, and is provided with a 3/4-horsepower motor. It is intended for wheels from 3 to 4 inches in diameter, and for operation on 180-cycle current.

The spindle is equipped with four ball bearings, and there is a large grease reservoir between the two bearings in each arm. The motor is of the squirrel-cage induction type, fully enclosed, and is like the usual induction motors running at 1800 and 3600 revolutions per minute, except for changes in the winding.

In addition to this model, grinders are made with



Forbes & Myers Grinder which Runs at 5400 Revolutions per Minute

an arm on one end only, and without the extension supporting arms. In the higher speeds, the grinders can be furnished with a threaded hole in the end of the spindle to provide a means for attaching the wheels, instead of with the flanges. An advantage pointed out for the use of high-frequency motors is that proper speeds can be obtained without the use of belts or gears, the wheels being mounted directly on the spindle.

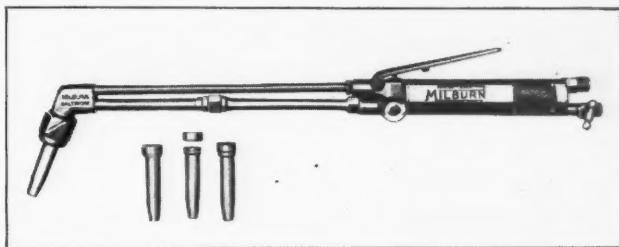
INGERSOLL-RAND PORTABLE AIR COMPRESSOR

A seventh size has been added to the line of portable air compressors manufactured by the Ingersoll-Rand Co., 11 Broadway, New York City. This new size has a bore of 4 3/4 inches, a stroke of 4 inches, and a piston displacement of 82 cubic feet per minute. Like other I-R portable compressors, this new size is equipped with a four-cylinder tractor-type Waukesha motor. It may be mounted on broad-faced steel wheels, steel wheels having rubber tires, a trailer, a Ford or Chevrolet truck, or a railroad car. It may also be furnished without a running gear, for mounting on skids.

MILBURN COMBINATION CUTTING AND WELDING TORCH

Cutting and welding may be performed with a type TI combination cutting and welding torch made by the Alexander Milburn Co., 1416-1428 W.

Baltimore St., Baltimore, Md., by merely turning the tip, it being unnecessary to change the tip. In one position of the tip, the gases are automatically passed through the preheating gas passages, while the high-pressure oxygen is carried through the central hole for cutting. In the next position of the tip, which is obtained by giving it a quarter turn, the cutting oxygen is cut off and the welding gases



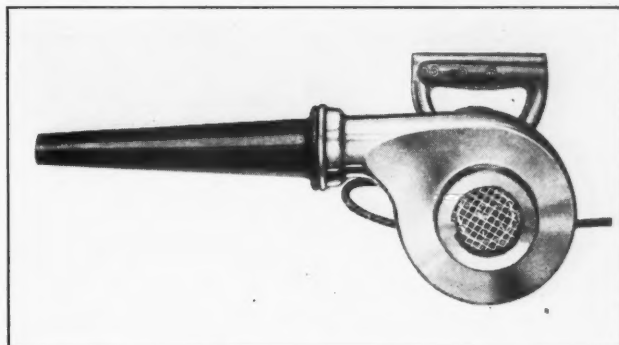
Milburn Cutting and Welding Torch with Convertible Tip

are conveyed through the central passage of the tip to make a welding flame. The new tip thus avoids the necessity of purchasing two sets of tips, one for cutting and one for welding.

PORTABLE COMBINATION BLOWER AND SUCTION DEVICES

The "Super Giant" portable electric-driven combination blower and suction device illustrated has been brought out by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. This model is equipped with a 1/3-horsepower air-cooled universal motor, which may be supplied for voltages from 100 to 175. It can be used for cleaning off machines, switchboards, motors, etc., and for spraying paint, varnish, and other liquids.

Another blower of somewhat similar design,



Portable Blower and Suction Device Made by the Ideal Commutator Dresser Co.

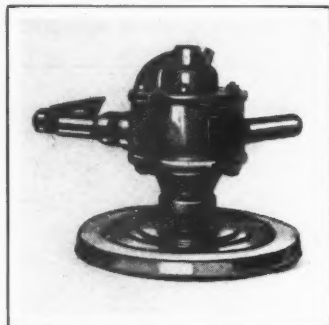
made by the same concern, can be used for blowing either hot or cold air. Suction attachments cannot be used with this device.

HERCULES PORTABLE SANDER AND GRINDER

Two recent developments of the Buckeye Portable Tool Co., 131-135 Wayne Ave., Dayton, Ohio, comprise a portable sander and grinder, both of which are driven by compressed air. The No. 62-5 sander, which is shown in the accompanying illustration, is particularly adaptable to the polishing of locomotive side-rods and the sanding of locomotive cab sides, cars, etc.

The grinder, which is similar in appearance to

one described in October, 1925, *MACHINERY*, is made in various models, sizes, and speeds for different classes of work. The high-speed grinder is well within the safety code rating, and is made in speeds ranging from 4800 to 6200 revolutions per



Hercules Portable Air-driven Sander

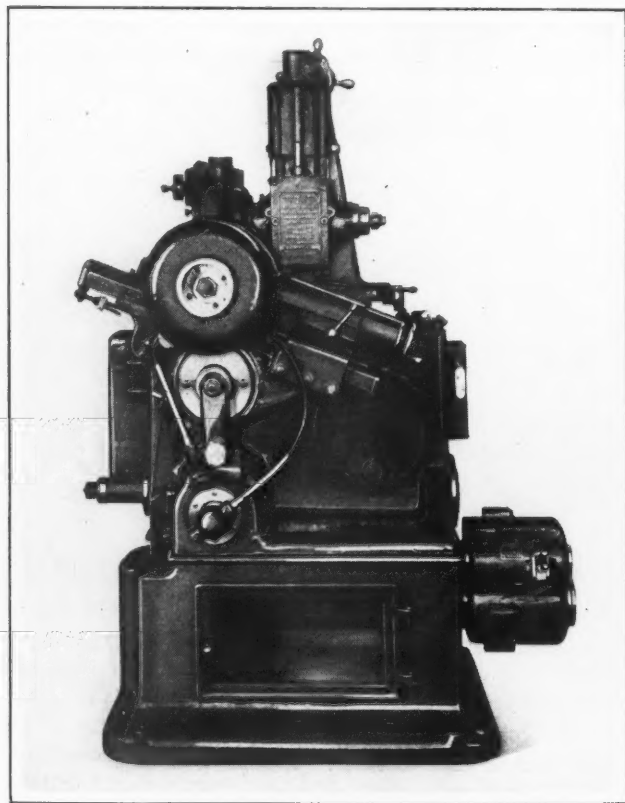
minute. Bakelite-, rubber-, or other elastic-bonded wheels may be used with it.

In these tools, the compressed air operates against movable blades, so arranged that while one or more blades take the live air, other blades are exhausting the dead air. This principle is said to eliminate all vibration. The only wearing parts are the small blades in the rotor, and repair of these is necessary only once in from four to six months. Lubrication is supplied through a fool-proof system, whereby grease is injected into the tool at one point and reappears from an outlet at the other end.

CHANGE-GEAR BOX FOR NATIONAL-CLEVELAND GEAR GRINDING MACHINE

A change-gear box has recently been developed by the National Tool Co., W. 117 St. and Madison Ave., Cleveland, Ohio, for application to the gear-tooth grinding machine described in April, 1926, *MACHINERY*, page 623. By means of this gear-box, 35, 50, 70, and 100 strokes of the machine are obtainable per minute. The illustration shows the location of the gear-box on the grinder.

This gear-box is fully ball-bearing, in line with



National-Cleveland Gear-tooth Grinding Machine with Change-gear Box

the ball-bearing design of the machine itself. The gears in the gear-box are of 10/8 diametral pitch, which gives a long tooth and unusually quiet running. In adopting this tooth for the gear-box gears, the usual order of things has been reversed, but the results are said to be decidedly worth while.

The gear-box has been so designed that it can be attached to any of the gear grinding machines by simply removing the Whitney silent chain and sprocket from the motor shaft and substituting a gear to engage the teeth of a 42-tooth gear in the gear-box. The silent chain is then placed on a 35-tooth sprocket of the gear-box. The motor being mounted in an adjustable frame, readily permits this installation and the proper adjustment. The gear-box is attached to the machine base by means of fillister-head cap-screws.

IMPROVED CARBORUNDUM WHEELS

Several new types of wheels have been brought out by The Carborundum Co., Niagara Falls, N. Y. One of these is a wheel for internal grinding, the object being to produce a fast cutting wheel that will hold its edges and remain true to shape, so as to eliminate bell-mouthed holes and produce the desired finish. These wheels are not bushed, but are so made that the arbor hole is in the exact center. This unbushed hole is finished to within very small limits of accuracy. Concentricity of the arbor hole and the grinding face, and uniformity in thickness, diameter, grit and grade are, therefore, the principal claims made for these wheels.

As an example of what these wheels have done in actual practice, it is mentioned that in grinding holes in a stamped steel housing, 1 15/32 inches in diameter by 2 1/4 inches long, removing 0.010 inch of metal on each side of the hole (0.020 inch on the diameter), fifteen wheels averaged 175 pieces each. The wheels were 1 3/4 inches in diameter, 1 1/2 inches wide, and had a 5/8-inch hole. The wheel speed was 9700 revolutions per minute, and the work speed, 650 revolutions per minute. The production per hour was increased 15 per cent over previous production figures.

A wheel with a "Redmanol" bond has been developed for snagging castings. The use of this bond makes it possible to operate a wheel safely at much higher speeds than could formerly be done with a vitrified wheel. The new wheel combines the strength of a rubber-bonded wheel, which is very dense, with the open porous structure of a vitrified wheel. As the rate of efficiency of grinding increases with the speed, and as in the past, a speed of only 5000 feet per minute was usually recommended for vitrified wheels, with an extreme limit of 6500 feet per minute, it is evident that a wheel which, like the "Redmanol" bond wheels, is recommended for a speed of 9000 feet per minute, will give much greater production. At the latter speed, the wheel has been found to be most efficient.

The porosity of the "Redmanol" wheel produces greater chip space and free-cutting properties, while the high tensile strength of the bond permits of the higher operating speeds. Formerly, these wheels were used only in the form of thin cutting-off wheels, but now snagging wheels are made up

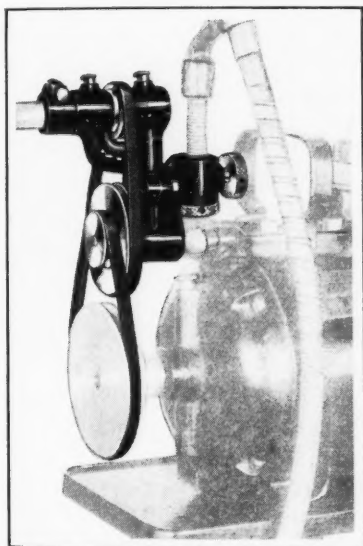
to 30 inches in diameter by 3 inches thick. To prevent breakage in case the wheel is abused or a casting jams, these wheels are reinforced by welded steel hoops molded inside of the wheel.

The construction of these wheels also permits straight wheels to be used now where taper-flanged wheels were formerly employed. Greater capacity is obtained without the use of more machines, because of the higher speed at which the machines and wheels may be operated.

Another new product of The Carborundum Co. consists of grinding disks for flat surfaces bonded with "Redmanol," the advantage of strength and porosity being the main features, as well as the fact that this bond is not affected by moisture. The grinding disks, therefore, can be used either wet or dry, and will remain flat in service, there being no tendency to warp or to break away from the steel plate backing. This, in turn, provides for uniform wear and eliminates the danger of pieces breaking out from the disk.

Crankshaft grinding wheels are now made by the vitrified process in larger sizes than formerly, the largest wheels now made by The Carborundum

Co. for this purpose ranging from 42 by 1 1/2 by 12 inches to 42 by 3 by 12 inches. Thin wheels of such large diameters as these have not formerly been made by the vitrified process; the advantage gained is less wheel wear for a given number of cranks being ground. These wheels are made in all standard grits and grades required in grinding crankshaft pins and journals.



Strand High-speed Attachment for Flexible-shaft Equipment

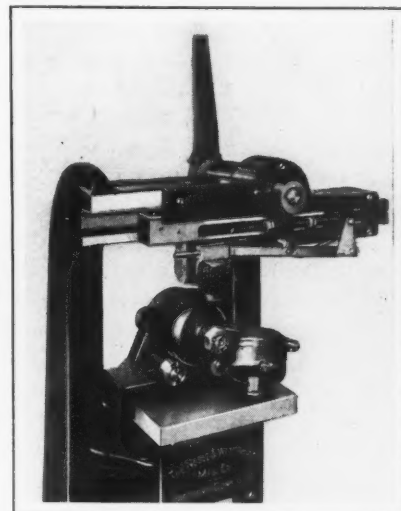
STRAND HIGH-SPEED ATTACHMENT

A speed of 10,000 revolutions per minute can be obtained with the Nos. 4 and 5 flexible-shaft grinding machines manufactured by N. A. Strand & Co., 5001-5009 N. Lincoln St., Chicago, Ill., through the use of a new high-speed attachment. This attachment is intended for use in driving small grinding wheels, and is fitted with ball bearings throughout. It is conveniently attached to the machines, less than one minute being required for changing over from the slower-speed countershaft regularly furnished.

The high speed of 10,000 revolutions per minute is obtained by compounding the belt drive. Wheels up to 2 inches in diameter may be operated at this speed. A ball-bearing hand-piece with a 1/4-inch collet or the regular ball-bearing hand spindle is provided for use in conjunction with the attachment. The high speed is particularly advantageous in grinding operations on dies and similar work.

NOBLE & WESTBROOK MARKING EQUIPMENT

Marking equipment recently placed on the market by the Noble & Westbrook Mfg. Co., Hartford, Conn., for producing serial numbers on curved surfaces, is shown in the illustration. This equipment consists of a Noble & Westbrook No. 3 hand-operated marking machine, provided with a special automatic numbering head and a workholder. As illustrated, the equipment is arranged for marking hydraulic shock-absorber parts.



Noble & Westbrook Marking Equipment for Curved Parts

The numbering head is fitted with a special shank to adapt it for use in the marking machine. An automatic tripping device attached to the head changes the numbering device to the next highest number after each mark is produced. The marking of the serial number is accomplished at the forward stroke of the numbering head over the work, the latter revolving on its own center on roller bearings. The wheels in the head can also be operated independently by disengaging the tripping device in case duplicate numbering is desired.

SPEED-BOX FOR GARVIN TAPPING MACHINE

Four selective spindle speeds are obtainable by means of a speed-box recently brought out by the Western Machine Tool Works, Holland, Mich., for application to the Garvin Nos. 2-X and 2-BG automatic tapping machines built by the company. This speed-box eliminates the single-speed reducer and may be furnished for either direct motor-driven or single-pulley driven machines. In the illustration it is shown applied to a machine equipped with a direct motor drive. The speed-box is fitted with Timken tapered roller bearings



Garvin Automatic Tapping Machine with Speed-box

throughout, in keeping with the design of the machine.

The gears are made of chrome-nickel steel and hardened. They may be quickly shifted from one speed to another, as the levers are within easy reach of the operator. The gears, Timken bearings, shafts, shifter forks, and lever fulcrums are all lubricated by a bath of oil.

When equipped with a motor running at 1200 revolutions per minute, the following spindle speeds may be obtained on the No. 2-X tapping machine: 223, 300, 432, and 582 revolutions per minute; while the following speeds are obtainable on the No. 2-BG tapping machine: 56, 76, 109, and 149 revolutions per minute. With a motor running at 1800 revolutions per minute, the speeds on the No. 2-BG machine would be 84, 114, 163, and 224 revolutions per minute.

* * *

DISPLAY STAND FOR MOTORS AND GRINDERS

With a view to increasing the sales of motors and motor-driven grinders manufactured by the Master Electric Co., Linden and Master Aves., Dayton, Ohio, that concern has brought out the display stand here illustrated which is sold to dealers and jobbers. The stand permits an attractive display of a motor and a motor-driven grinder. It is constructed of angle-irons and metal plates, is 15 3/4 inches wide, 21 1/8 inches deep, and 46 inches high.

* * *

STEEL AND POWER SHOW IN CANADA

A steel and power show similar to that held last fall at Toronto, Ontario, will be held this year, September 4 to 7, inclusive, in the University of Toronto Arena. It is considered the outstanding engineering event of the year in Canada, and is expected to include 140 exhibitors. The show is conducted without profit, and cooperates with the Canadian Section of the American Welding Society, the Engineers' Mutual Benefit Fund, the Canadian Engineering Standards Association, the Industrial Accident Prevention Association, and the Montreal Chapter of the American Society for Steel Treating. Campbell Bradshaw, 24 Front St. West, Toronto, Ontario, is secretary of the organization handling the show.

* * *

The Taylor Society met at the Detroit-Leland Hotel, Detroit, Mich., May 7 to 9, in conjunction with the Society of Industrial Engineers and the Society of Time Study Engineers. Time and motion study and the analysis of operations formed the keynote of the meeting, and most of the papers dealt with one or more phases of these subjects. For further information on the papers, address the Taylor Society, 29 W. 39th St., New York City.

IS VOLUME OF BUSINESS ALWAYS PROFITABLE?

Fewer varieties, fewer customers, and restricted territory for the individual distributor as a basis for higher net profits were said to be the lines along which the next great advance in selling would be made, in an address before the National Association of Electrical Supply Jobbers, by Alvin E. Dodd, manager of the Domestic Distribution Department of the United States Chamber of Commerce. It was pointed out that frequently inevitable losses result from the strenuous efforts made to obtain the last unprofitable 10 per cent of the annual business.

As an interesting example of how smaller volume may be accompanied by greater profits, Mr. Dodd quoted the following case: One hardware jobber reduced by about 20 per cent the number of manufacturers from whom he bought, and by about 30 per cent the number of varieties that he carried. He then reduced the number of his customers by 56 per cent and the area covered by his salesmen by 28 per cent. This does not mean that he refused to sell to 56 per cent of his customers, but merely that he ceased to solicit their business through his salesmen.

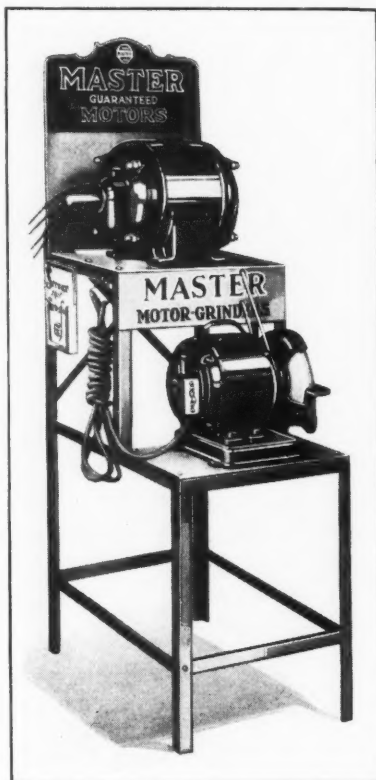
After the plan had been in operation for a year, the net profits had increased more than one-third and the percentage of profits to gross sales had increased more than two-thirds, in spite of the fact that he carried fewer varieties, served fewer customers, and operated in a smaller territory.

While this does not apply with equal force to all business, there is a significance in this experiment that should be pondered by every man in business. It often happens that the last 10 or 20 per cent of the annual volume of business is obtained at such a high selling expense that it consumes a large part of the profits of the remainder of the business.

* * *

STEEL TREATING CONFERENCE AT PURDUE UNIVERSITY

On May 10 and 11 a steel treating conference was held at Purdue University, Lafayette, Ind., under the direction of the Engineering Extension Department and the Department of Practical Mechanics in cooperation with the School of Chemical Engineering and the Indianapolis and Fort Wayne Sections of the American Society for Steel Treating. A number of valuable papers were read, dealing with the manufacture of iron and steel; alloy steels; methods of determining critical temperatures; the study of physical properties of metals through the microscope; carburizing; quenching of high-speed steel; stainless and heat-resisting steels; heat-treating furnaces; and the heat-treatment of malleable castings.



Display Stand for Master Motors and Grinders

OPERATIONS ON AUTOMOBILE DOOR HINGES

Two machines equipped for drilling, reaming, tapping, and countersinking operations on door hinges for automobiles have recently been built by the Davenport Machine Tool Co., Inc., 167 Ames St.,

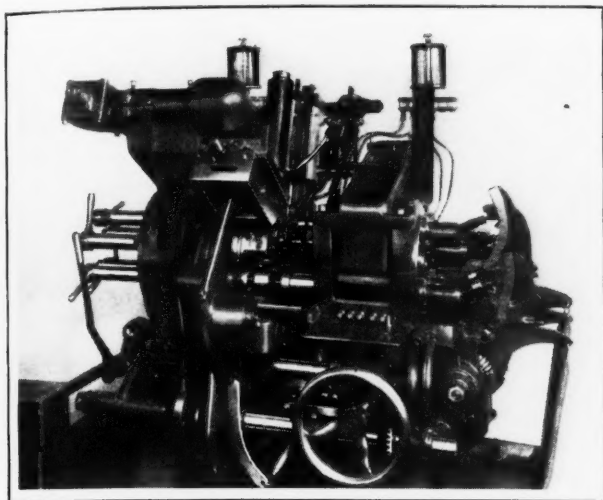


Fig. 1. Davenport Automatic, Modified for Drilling, Reaming and Tapping Hinges

Rochester, N. Y. One of these machines consists of the regular automatic screw machine, modified as illustrated in Fig. 1 for producing the holes in the male hinge part shown in Fig. 2. The second machine (Fig. 3) is the standard non-stop automatic drilling machine equipped for drilling and countersinking three holes in the hinge part, Fig. 4.

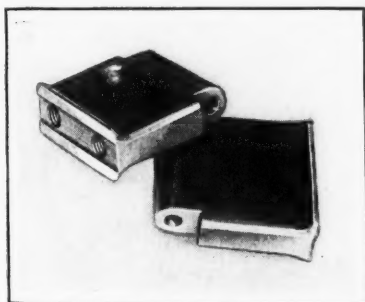


Fig. 2. Hinge Part Machined in the Davenport Automatic

The tool mechanism of the screw machine is reversed, compared with the regular machine, the tools being revolved while the work is held stationary. The hinge is placed in a fixture located in the position usually occupied by the work-spindle and is clamped by one of the five handles seen at the left of the machine. The pin-hole in the hinge is drilled by revolving drills on the right-hand end of the machine, the first drill being guided by a bushing located close to the work and drilling about one-third of the hole depth. In the succeeding steps of the operation, drills in other positions complete the pin-hole, and in the last position, it is reamed.

During these steps, drill spindles mounted on cross-slides drill the holes used for fastening the hinge to the car body. One set of drills drills the holes to a part of their depth, and a second set finishes them to the entire depth, after which the holes are tapped by a third set of tools. These holes

employed in fastening the hinge to the car body are only 1 inch apart, but the drill spindles are so arranged that the driving gears may be of a fair size, and each spindle has an independent lengthwise adjustment to suit drill lengths.

The longest hole that is drilled is 1 3/8 inches long. The hinges are drilled, reamed, and tapped at rates varying from 260 to 400, and over, per hour, depending upon the carbon content of the material and the ability of the operator. Each tool has an independent feed control, so that its feed may be just right for the allotted work, this being a regular feature of the Davenport screw machine.

The non-stop drilling machine shown in Fig. 3 has five sets of work-holding fixtures and drilling heads which revolve continuously. The operator of this machine merely places hinge parts in the fixtures, and as the fixture unit revolves, the work is automatically located and clamped. Three spindles in a cluster box on the left-hand end of the machine drill and countersink the three holes simultaneously. Then when these spindles have withdrawn, three spindles on the right-hand end approach and countersink the holes from the other side of the hinge. When this step has been performed, the clamping device automatically releases and the work drops into a pan, leaving the fixture open to receive a new piece.

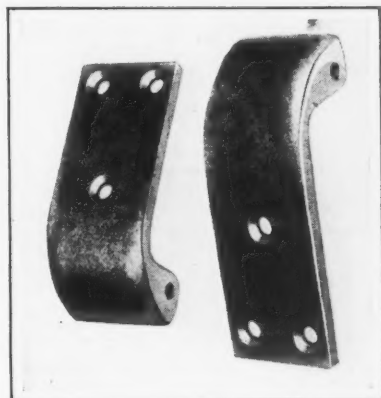


Fig. 4. Hinge Part Drilled and Countersunk Simultaneously

As there are always four pieces being worked on simultaneously, high rates of production are obtainable. In this particular operation, a production of 1200 hinges per hour was obtained.

Although the center distance between the spindles is close, it is enough to permit driving the spindles with good-sized hardened gears. The spindles are fed by cams located on the ends of the machine. Cutting compound is supplied to each of the drills by a geared pump.

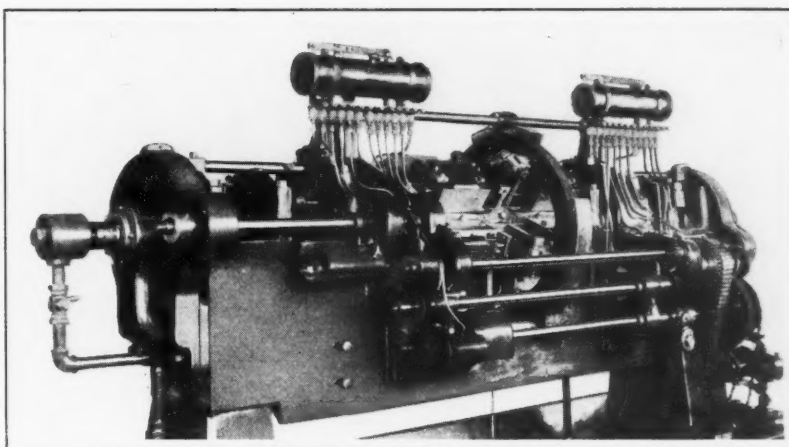


Fig. 3. Non-stop Automatic Drilling Machine Equipped for Drilling and Countersinking Hinge Parts

The NEW BROWN & SHARPE PLAIN GRINDING MACHINES

A Completely New Series *that sets an Advance*

TO meet today's demand for better grinding, and to anticipate your future requirements, the Brown & Sharpe Mfg. Co. announces an entirely new line of High Production Plain Grinding Machines.

No. 30

12" x 18"

No. 32

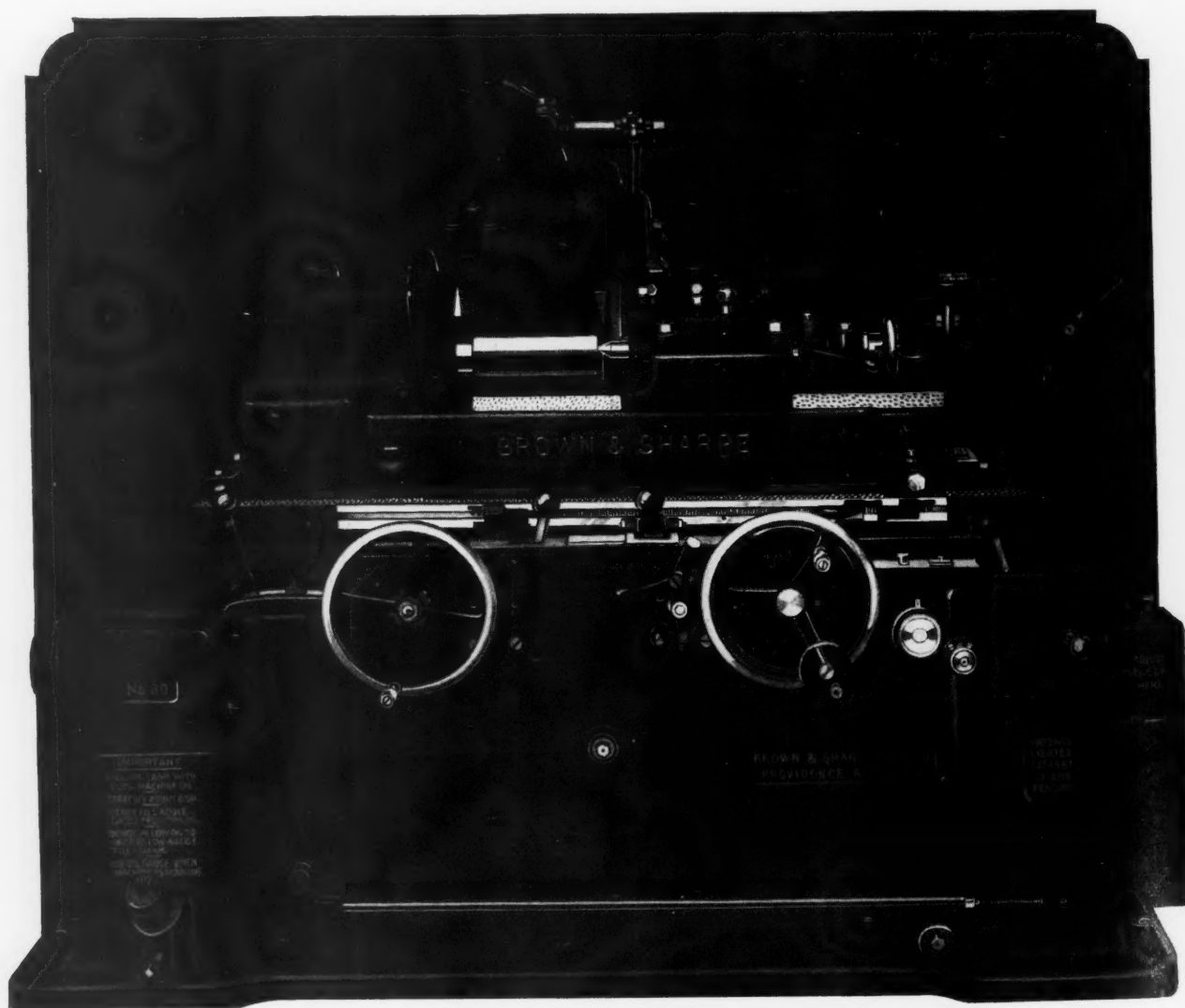
12" x 36"

No. 33

12" x 48"

MODIFIED MACHINES—Nos. 30A, 32A, and 33A (Power Table Feed for Wheel Truing, and Power Cross Feed) are designed for straight-in-feed grinding, using either power or hand cross feeds.

Nos. 30B, 32B and 33B (Hand Table and Cross Feeds) are designed for straight-in-feed grinding, using hand cross feed only.



PLAIN GRINDING MACHINES

Advanced Standard of Performance

*Distinctive Features that offer you
more Profitable Production*

FLEXIBILITY and SIMPLICITY of OPERATION

Simplified and centralized controls . . . Single lever for nine table speed changes, 17" to 373" per minute . . . Single lever for six work speed changes, 42 to 270 R.P.M. . . . Single dials, with wide spaced graduations, control amount of automatic cross feed and point of feed throw-out . . . Automatic cross feed provided for straight-in-feed grinding with table stationary . . . Footstock may be operated either by spring lever or by screw and handwheel . . . Flow of coolant stops automatically when work spindle is stopped . . . Three changes of wheel spindle speed to suit varying wheel diameters . . . Spindle takes 24" wheels to 10" wide and 30" wheels to 6" wide.

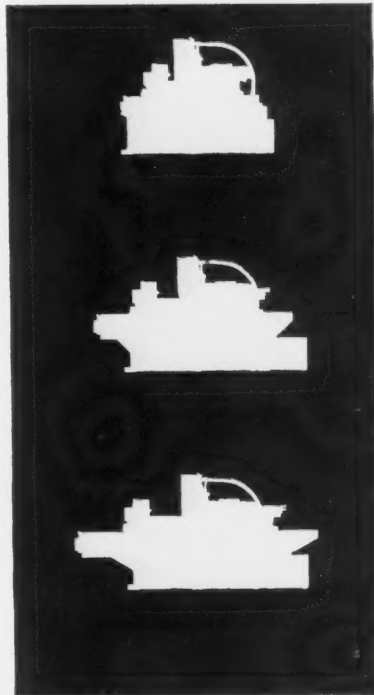
ABUNDANT POWER

Designed to use up to 40 H.P., with ample provision for overloading . . . Power supplied through 8" double belt to main driving shaft on rear of machine, from single motor located in base or from overhead countershaft . . . Wheel spindle, table and headstock gear case, and coolant pump, driven by belts from main driving shaft (8" double belt to wheel spindle) . . . Correct tension automatically maintained in driving belts . . . Anti-friction bearings widely used.

ENDURANCE and ACCURACY

One-piece bed, long and heavy, proportioned to preserve alignments . . . Massive wheel slide fully supported in all positions—advanced by large screw and nut . . . Wheel spindle, gear case, and other main mechanisms automatically lubricated with filtered oil . . . Unique adjustment for wheel spindle boxes prevents application of excessive pressure on spindle . . . Wheel spindle and pulley dynamically balanced . . . Headstock cast integral with table, with final work drive by belt from within machine . . . Table reverses without shock at all speeds . . . Adjustable dwell for table at point of reversal.

Comparative Sizes of the New
Plain Grinding Machines



A booklet describing many features of the New Machines and specifications of any size that interests you will be sent at your request.

BROWN & SHARPE

BROWN & SHARPE MFG. CO.



PROVIDENCE, R. I., U. S. A.

PERSONALS

F. T. LLEWELLYN of the United States Steel Corporation was elected president of the American Welding Society at its annual meeting on April 26.

R. W. WALES has been appointed factory representative on molding powders and resins for the Celoron Co. (Division of the Diamond State Fibre Co.), Bridgeport, Pa.

ROBERT J. ANDERSON, director of research of the Fairmont Mfg. Co., Fairmont, W. Va., manufacturer of aluminum sheets and coils, was elected a vice-president of the company at the last meeting of the board of directors.

C. P. POTTER, engineer in charge of large motor and transfer divisions of the Wagner Electric Corporation, St. Louis, Mo., has been elected chairman of the St. Louis section of the American Institute of Electrical Engineers.

THOMAS S. STEPHENS, for the last twenty-five years connected with the machinery sales activities of Manning, Maxwell & Moore, Inc., New York City, latterly serving as manager of railroad machinery sales, has resigned.

ALFRED E. MUNCH, JR., has been appointed representative in the Chicago-Milwaukee district of the Rollway Bearing Co., Inc., Syracuse, N. Y. Mr. Munch's headquarters will be at 544 Railway Exchange Building, Chicago, Ill.

C. W. STONE, manager of the General Electric central station department, has been appointed consulting engineer for the company, and M. O. TROY has been appointed manager of the central station department in Mr. Stone's place.

THEODORE BERAN, commercial vice-president of the General Electric Co., Schenectady, N. Y., in charge of the New York district, has retired. Mr. Beran, who was elected vice-president in 1926, had been manager of the New York district since 1903.

W. H. POST has been appointed manager of the Pittsburgh branch office of the Timken Roller Bearing Service and Sales Co. Mr. Post has been connected with the company for several years, during which time he has been active in sales work in the Cleveland district.

E. D. PIKE, previously in charge of the Pacific Coast service operation for the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo., has been made manager of the San Francisco branch sales office. Mr. Pike has been associated with this company for twenty-six years.

J. C. GOODNIGHT has joined the selling force of the Detroit office of the Black & Decker Mfg. Co., Towson, Md. Mr. Goodnight will specialize in automotive work. HENRY FOX, who previously handled this work at Detroit, has gone into business for himself. LEON A. HARDY will replace JACK CAFFEY as salesman in the New York branch of the company.

KENNETH GRANT, formerly of the Machinists' Supply Co. of Chicago, has recently joined the sales organization of the Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill. He will cover territory in southern Wisconsin, northern Illinois, and eastern Iowa. His headquarters for the present are at the general offices in Chicago, but may later be moved to Rockford, Ill.

RALPH SIMPSON has been placed in charge of the sales and servicing of Geometric tools and equipment in eastern New England, comprising the states of Maine, New Hampshire, Rhode Island, and eastern Massachusetts. Mr. Simpson has had a wide experience in the machine tool field, having previously been sales manager of the Stockbridge Machine Co., and prior to that, with the Potter & Johnston Machine Co.

MARCUS CHASE, sales manager of the Niles-Bement-Pond Co. of Massachusetts, has resigned and is retiring, after twenty-nine years of continuous service with the company, for a well deserved rest. During the last seventeen years of his association with this company, Mr. Chase has been manager of the Boston office. He will be succeeded by M. S. BRADLEY, who has been assistant to Mr. Chase for nearly fifteen years.

E. E. ARNOLD, after an absence of twenty years, has again become associated with the Westinghouse Electric & Mfg. Co., special assignment. Mr. Arnold has had thirty years' experience in designing, testing, consulting, and executive capacities in the mechanical engineering field. He has previously been associated with the Metal Products Co., of Detroit, Mich., the A. O. Smith Co. of Milwaukee, Wis., and the New Departure Mfg. Co., of Bristol, Conn.

STANLEY W. PARKER has been appointed district manager of the Chicago office of Wheelock, Lovejoy & Co., Inc., with headquarters in the Pure Oil Building, 35 E. Wacker Drive, Chicago, Ill. Mr. Parker has been connected with the company for the last twelve years at the home office in Cambridge, Mass., as metallurgist and sales engineer. Previous to that, he was in the metallurgical department of the Pennsylvania Steel Co. at Steelton, Pa.

C. A. WALES, formerly branch manager for Henry Prentiss & Co. of New York City, has joined the sales organization of the Henry G. Thompson & Son Co., New Haven, Conn., manufacturer of "Milford and Mil Flex" hacksaw blades. Mr. Wales, who was formerly purchasing agent of the Federal Signal Co. of Albany, N. Y., and president of the Purchasing Agents' Association of Eastern New York, will represent the Henry G. Thompson & Son Co. in the state of Ohio.

WILLIAM J. SERRILL, assistant general manager of the United Gas Improvement Co., Philadelphia, Pa., has been elected chairman of the American Engineering Standards Committee. Mr. Serrill succeeds C. E. SKINNER, of the Westinghouse Electric & Mfg. Co., who has been chairman for the last three years. The vice-chairman during the coming year will be CLOYD M. CHAPMAN, engineering specialist of New York City and representative of the American Society of Mechanical Engineers.

W. H. FISHER, vice-president of the T. B. Wood's Sons Co., Chambersburg, Pa., and president of the Power Transmission Association, left for Europe, May 12, sailing on the *Conte Biancamano* for Naples. He is accompanied by Mrs. Fisher and will visit Italy, Hungary, Austria, Germany, France, and England, returning about the middle of August. During his tour, Mr. Fisher will study the transmission business and industrial conditions in Europe. The executive committee of the Power Transmission Association gave a farewell luncheon to Mr. Fisher at the Hotel Commodore, New York, May 11.

P. E. MONTANUS, president of the Springfield Machine Tool Co., Springfield, Ohio, who has been a resident of Coral Gables, Fla., for the last four years, was elected mayor of Coral Gables on May 4 by the unanimous vote of the other city commissioners. Mr. Montanus is well known in the machine tool industry, being one of the pioneers among the Ohio machine tool builders. He is also one of the organizers and a vice-president of the Citizens' National Bank of Springfield, Ohio, and chairman of the board of directors of the Third National Bank of Miami, Fla. While not at present active in the management of the Springfield Machine Tool Co., he is in constant touch with the concern, which is being managed by his two sons, Paul A. and Edward S. Montanus.

OBITUARIES

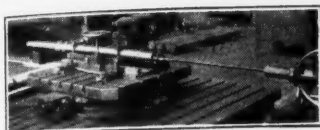
GEORGE ALVORD EDE, founder of the Cobden Machine Works, Cobden, Ill., died on April 14.

WILLIAM T. EMMES, vice-president of the Boye & Emmes Machine Tool Co., Cincinnati, Ohio, died in Cincinnati at the Good Samaritan Hospital on May 2, following a long illness. Mr. Emmes was born in Winchester, N. H., in 1863, and went to Cincinnati in 1893 where he became connected with the R. K. LeBlond Machine Tool Co. In 1898, he became superintendent of Dietz, Schumacher & Boye, which was reorganized later as the Schumacher & Boye Co. In 1912 this company was succeeded by the Boye & Emmes Machine Tool Co. Mr. Emmes becoming vice-president and a member of the firm. He had not been actively engaged in business for the last three years.

PAUL T. BRADY, who was associated with the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for thirty-four years, died suddenly of heart failure on May 3 at the home of his son, Arthur J. Brady in Portland, Ore. Mr. Brady was born in Cooperstown, N. Y. in 1856. He attended the Exeter Academy and taught school for two years after graduation. In 1894 he became New York State manager of the Westinghouse Electric & Mfg. Co., with headquarters in Syracuse, and in 1907 was transferred to New York City as special representative of the company, which position he held at the time of his death. He is survived by his widow, five sons, and five daughters.

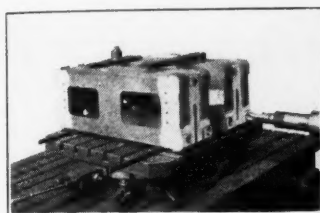
ALEXANDER W. COPLAND, president of the Copland Gear Lapping Syndicate, Detroit, Mich., died on April 23 at Birmingham, Mich., aged sixty years. Mr. Copland became

TYPICAL PERFORMANCE



Drilling Jack Shaft

A number 1, Ryerson Horizontal drilling a 1" hole, 36" deep and a 1" hole 15" deep in Hyten steel 45 carbon. Jack shaft weighing 225 pounds mounted on turntable with special automatic jig for quick movement of shaft.



Drilled From Four Positions—One Set-up

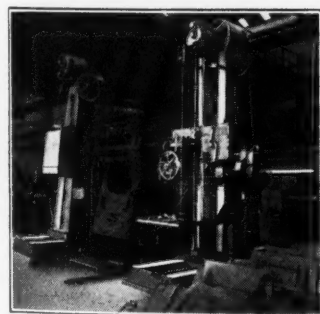
Two castings 12" x 18" x 4' weighing 450 pounds mounted on a 4 foot revolving table. Drilled from four positions with the one set-up.

Four 1 3/4" holes drilled through 1" material.

Two 1 3/4" holes drilled and reamed through 1/2" material.

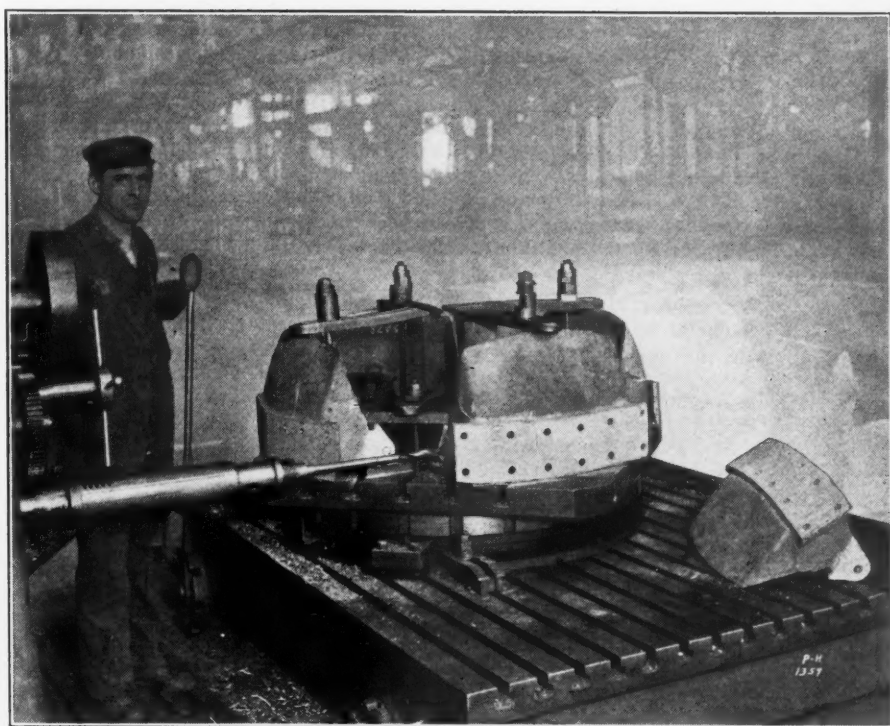
Eight 11/16" holes drilled through 5/8" material.

Floor to Floor Time, 1 1/2 hours for two pieces.



A Very Accurate Job

Two number 12 Ryerson Horizontal Drilling and Boring Machines at work on a gun carriage at the Watertown Arsenal, Watertown, New York. Drilling, boring, facing and tapping carriage parts.



20 Buckets — 14 1/4 Hrs.

*Every Pair of Holes at a
Different Angle*

This job is typical of the time and labor that are saved by a Ryerson Horizontal Drill.

Four ditcher buckets, each weighing eighty-five pounds, were mounted on a 4 foot turntable and each drilled from eight positions with the one clamping. Twelve 13/16" holes were drilled through 1 1/8" material and two 1" holes through 3/4" material in each bucket. Twenty buckets were handled in 14 1/4 hours, floor to floor time.

All jobs—small pieces on a production schedule or the largest castings—can be economically handled on a Ryerson Horizontal. Let us send you the facts.

Write for Bulletin 4051

JOSEPH T. RYERSON & SON INC.

ESTABLISHED 1842

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Pittsburgh, Philadelphia, Boston, Jersey City, New York, Richmond, Houston, Dallas, Tulsa, Los Angeles, San Francisco, Denver, Minneapolis, Duluth

Drill it Horizontally

widely known through the invention of a cake baking machine which revolutionized previous methods of baking. At the time of the invention he was manager of the National Biscuit Co.'s plant at Schenectady, devoting himself to the production of baking machinery. Subsequently, he became connected with the Detroit Machine Gear Co., two years ago retiring from that concern to form his own company, the Copland Gear Lapping Syndicate. Just previous to his death he had perfected an accurate gear lapping machine. Mr. Copland was a member of the board of directors of the American Gear Manufacturers' Association, having served on the board since 1922.

JAMES J. WOOD, consulting engineer of the Fort Wayne Works of the General Electric Co. and one of the pioneers of electric lighting by arc lamps in America, died suddenly April 19 at Asheville, N. C., from heart disease. He had just passed his seventy-first birthday. Mr. Wood was born at Kinsale, Ireland, and came to America when he was eight years old. In 1874, at the age of eighteen, he graduated from the Brooklyn Evening High School and, in 1878, from the Brooklyn Polytechnic Institute. His interest in electric lighting had been aroused meanwhile, and in 1879 he designed an arc-light dynamo. After about ten years as electrical inventor in New York, Mr. Wood went to Fort Wayne, in 1890, as the result of a commercial agreement with the old Thomson-Houston Co. He was located there up to the time of his death, as the outstanding electrical engineer of the Fort Wayne plant.

TRADE NOTES

BROWN INSTRUMENT Co. has secured larger quarters for its Pacific Coast branch at 420 Westinghouse Electric Building, 420 S. San Pedro St., Los Angeles, Cal.

SOUTH BEND LATHE WORKS, 786 E. Madison St., South Bend, Ind., has appointed the Mills-Lipton Co., 1160 Market St., Chattanooga, Tenn., dealer for South Bend lathes.

HYDRAULIC PRESSED STEEL Co., Cleveland, Ohio, has been purchased by the TRUSCON STEEL Co., of Youngstown, Ohio, and will be operated as the PRESSED STEEL DIVISION OF THE TRUSCON STEEL Co.

INGERSOLL-RAND DRILL Co., 314 N. Broadway, St. Louis, Mo., has been succeeded by Ingersoll-Rand, Inc. A new branch, operating under the St. Louis office, has been opened at 226 West A St., Picher, Okla.

ECONOMY ENGINEERING Co., Willoughby, Ohio, manufacturer of automatic bolt and nut machinery, has awarded a contract to Frank S. Bones & Son of Willoughby for the construction of a one-story addition to its factory, which will increase the floor area 50 per cent.

SAGINAW MACHINE & TOOL Co., Throop and Niagara St., Saginaw, Mich., maker of tools and dies, has recently erected a new building containing 5600 square feet of floor space. Frank Woigdka is general manager of the company, and P. J. Kessel, superintendent.

AMERICAN FLUID MOTORS Co., Philadelphia, Pa., manufacturer of hydraulic pumps, motors, and transmissions, has appointed Harry H. Leathers, 80 Federal St., Boston, Mass., New England agent for the company. R. L. Sittinger will be associated with Mr. Leathers in sales work.

STUEBING COWAN Co., of Cincinnati, Ohio, and Holyoke, Mass., has moved its New England plant into larger quarters. A complete stock of standard model lift trucks will be carried at Holyoke, so that all the New England and eastern business will be taken care of by the Holyoke factory.

AMERICAN MANGANESE STEEL Co., Chicago, Ill., announces that it has developed a number of specially designed parts from manganese steel for severe service in cranes, tractors, and excavating machinery. This equipment demands a tough steel that will resist wear and abrasive conditions under metal-to-metal contact and that will also stand up under shocks.

CHARLES BOND Co., Philadelphia, Pa., is this year observing the fortieth anniversary of the foundation of the company. From a small mill supply business occupying 600 square feet of floor space, it has grown to a point where it occupies 75,000 square feet of office and warehouse space in Philadelphia. In addition, the company maintains manufacturing plants in other localities.

CHAIN PRODUCTS Co., Cooper Ave. and Pennsylvania Railroad, Cleveland, Ohio, manufacturer of a complete line of Hodell chains, has moved its New York branch from 150 Chambers St. to 200 Varick St. Thomas A. Troy is the New York manager in charge. A second plant has recently been equipped on Lakeside Ave. in Cleveland, which will be devoted exclusively to the manufacture of Hodell tire chains.

ROLLER BEARING Co. OF AMERICA, 141 Frelinghuysen Ave., Newark, N. J., has just concluded the purchase of the plant of the Mercer Motor Car Co. in Trenton, N. J. The Roller Bearing Co. of America will move its present equipment to that plant and will install a large amount of new equipment to take care of its growing business. The Mercer plant occupies 11 1/2 acres, and the buildings have 175,000 square feet of floor space.

BOLT, NUT AND RIVET MANUFACTURERS' ASSOCIATION, 311 Ross St., Pittsburgh, Pa., has issued a booklet containing an outline of a plan for a national conference to discuss the question of proper sales and distribution of products of American manufacturers which are distributed either all or in part through hardware, jobbing and mill supply channels. Those interested in such a conference are requested to communicate with Charles J. Graham, president of the association mentioned.

BOSTON GEAR WORKS, INC., Norfolk Downs, Mass., manufacturer of standardized gears, speed reducers, and power transmission equipment, has erected a three-story addition to its plant at Norfolk Downs, Mass. The new building is 67 by 95 feet, having walls of brick and concrete and floors of heavy construction supported by heavy lumber and steel girders. Ample lighting facilities are provided. A special feature of the new structure is a spacious recreation hall, located on the third floor.

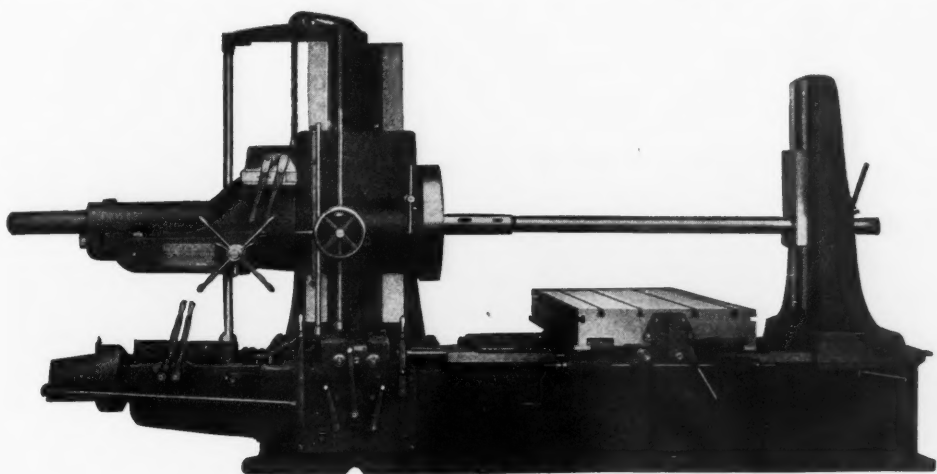
GRISCOM-RUSSEL Co., manufacturer of evaporators, feed-water heaters, air coolers and heaters, oil coolers, condensers, etc., has recently purchased the major part of the Russell & Co.'s plant adjoining its own plant at Massillon, Ohio. The newly acquired buildings include machine shops, tool-room, boiler shops, sheet-metal and coil shop, pattern shop, carpenter shop, and many other departments, which have been rearranged and equipped throughout with modern types of precision machinery and special apparatus.

BLACK & DECKER MFG. Co., Towson, Md., has recently made several changes in its sales organization, and the following men are now selling the Black & Decker line of portable electric tools in the territories indicated: H. L. Balke is with the Kansas City branch, covering the territory around Omaha formerly covered by S. D. Shawgo; G. F. Parr is with the Buffalo office, and has taken over the territory of J. H. Hutton; G. N. McCarthy has filled the vacancy at the Buffalo office made by the transfer of H. B. Austin to Chicago; J. A. Murray is working in Baltimore, taking over the accounts formerly handled by Curtiss Watts.

PAUL H. PETERSON, INC., is a corporation recently formed with offices in the Graybar Building, New York City, for the purpose of giving technical and financial aid to American manufacturers of machinery in the development of foreign markets. The company will represent manufacturers in procuring business for them, protecting their credit losses, and furnishing finances to meet demands for long-term credits. It will specialize in machine tools, railway equipment, road-building machinery, textile machinery, laundry and baking machinery, electric and hydraulic equipment, and shoe and sugar machinery. Paul H. Peterson, the president, is an engineer, and was formerly export manager of Joseph T. Ryerson & Son, Inc., Chicago, Ill.

GAIRING TOOL Co., Detroit, Mich., has just moved into a new factory building located at 1635-37 W. Lafayette Boulevard, where three times the office and factory space, as compared with the company's former shop, will be available. The new facilities were made necessary by the growth of both domestic and foreign business in the company's line of cutting tools, including counterbores, spot-facers, core-drills, multiple-operation tools, and full-floating holders and nose-drive reamers. Sufficient new equipment has also been added at this time to double the present manufacturing capacity, and the increased engineering facilities made possible by the expansion, will enable the company to act in a consulting capacity on any special cutting tool problem. The new factory is of thoroughly modern steel and brick construction, two stories, with light from all four sides.

QUANTITY WITH QUALITY



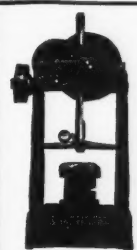
The new model, larger sizes of the

LUCAS "PRECISION"

Horizontal Boring, Drilling and Milling Machine
with 4 inch and 5 inch spindles,

because of their greater rigidity and power are capable of taking heavier cuts at faster speeds and coarser feeds, without sacrifice of accuracy. This, together with provision for easier manipulation, means lessened machining time.

Set-up and handling time are also greatly reduced by the single set-up on this versatile machine, for boring, drilling and milling operations in accurate relation.



WE ALSO MAKE THE
LUCAS POWER
Forcing Press

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U. S. A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

COMING EVENTS

JUNE 4-6—Fourteenth annual convention of the American Association of Engineers at El Paso, Tex.; headquarters, Hotel Hussman. Chairman of local committee, L. M. Lawson, First National Bank, El Paso, Tex. Further information can be obtained from the secretary, M. E. McIver, 63 E. Adams St., Chicago, Ill.

JUNE 14-16—Oil and Gas Power meeting of the American Society of Mechanical Engineers at State College, Pa. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 20-27—Annual meeting of the Mechanical Division V of the American Railway Association in Atlantic City, N. J.

JUNE 20-27—Annual convention and exhibition of the Railway Supply Manufacturers' Association in Atlantic City, N. J. Secretary-treasurer, J. D. Conway, 1841 Oliver Bldg., Pittsburgh, Pa.

JUNE 25-29—Annual meeting of the American Society for Testing Materials at Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

JUNE 25-29—Annual meeting of the Society for the Promotion of Engineering Education at the University of North Carolina, Chapel Hill, N. C. For further information, address Dean Braune, University of North Carolina.

JUNE 26-29—Semi-annual meeting of the Society of Automotive Engineers at the Chateau Frontenac, Quebec, Canada. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

JUNE 27-29—Second annual meeting of the Motor Bus Division of the American Automobile Association at the Hotel Gibson, Cincinnati, Ohio. For further information, address the American Automobile Association, Washington, D. C.

JUNE 28-29—Aeronautic Division meeting of the American Society of Mechanical Engineers at Detroit, Mich. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

AUGUST 27-29—Regional meeting of the American Society of Mechanical Engineers at St. Paul-Minneapolis, Minn. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

SEPTEMBER 4-7—Canadian Steel and Power Show, University of Toronto Arena, Toronto, Ontario, Canada. Campbell Bradshaw, secretary, 24 Front St. West, Toronto.

SEPTEMBER 5-22—Fourth Machine Tool and Engineering Exhibition to be held at Olympia, London, England.

SEPTEMBER 12-14—Annual convention of the American Railway Tool Foreman's Association in Chicago, Ill.; headquarters, Hotel Sherman. Secretary and treasurer, F. A. Armstrong, 564 W. Monroe St., Chicago, Ill.

SEPTEMBER 17-20—Second national meeting of the Fuels Division of the American Society of Mechanical Engineers to be held in Cleveland, Ohio. Chairman of Fuels Division, Victor J. Azbe, American Society of Mechanical Engineers, 29 W. 39th St., New York City.

SEPTEMBER 24-27—National Machine Shop Practice meeting of the American Society of Mechanical Engineers in conjunction with the Cincinnati Section of the society. L. C. Morrow, Tenth Ave. and 36th St., New York City, chairman of the Machine Shop Practice Division of the A.S.M.E.

OCTOBER 8-12—Tenth National Metal Exposition held under the auspices of the American Society for Steel Treating at the Commercial Museum, Philadelphia, Pa. For further information, address W. H. Eisenman, National Secretary, 4600 Prospect Ave., Cleveland, Ohio.

OCTOBER 11-13—Semi-annual meeting of the American Gear Manufacturers' Association at the Hotel Statler, Buffalo, N. Y. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

JANUARY 14-18, 1929—Western Metal Congress and Western States Metal and Machine Tool Exposition at Los Angeles, Cal., under the

auspices of the American Society for Steel Treating; headquarters, Shrine Auditorium. Secretary, W. H. Eisenman, 7016 Euclid Ave., Cleveland, Ohio.

SOCIETIES, SCHOOLS AND COLLEGES

POLYTECHNIC INSTITUTE OF BROOKLYN, 99 Livingston St., Brooklyn, N. Y. Seventy-third annual catalogue of the College of Engineering (1928-1929).

OHIO MECHANICS INSTITUTE, Central Parkway and Walnut St., Cincinnati, Ohio. Catalogue for 1928-1929 describing courses of instruction and giving other data relating to the institute.

NEW BOOKS AND PAMPHLETS

MANAGEMENT'S PART IN MAINTAINING PROSPERITY. By L. W. Wallace, executive secretary, American Engineering Council, Washington, D. C. 11 pages, 6 by 9 inches. Published by Purdue University, Lafayette, Ind., as Circular No. 10 of the Engineering Extension Department.

A METALLOGRAPHIC STUDY OF THE PATH OF FATIGUE FAILURE IN COPPER. By Herbert F. Moore and Frank C. Howard. 31 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 176 of the Engineering Experiment Station. Price, 20 cents.

SPECIFICATIONS FOR THE MANUFACTURE AND INSTALLATION OF TWO-SECTION KNIFE-EDGE RAILROAD TRACK SCALES. 22 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 333 of the Bureau of Standards.

IMPROVED METHOD OF VISUALIZING AND PHOTOGRAPHING THE DIELECTRIC FIELD. By R. H. George, K. A. Oplinger, and C. F. Harding. 29 pages, 6 by 9 inches. Published by Purdue University, Lafayette, Ind., as Bulletin No. 29 of the Engineering Experiment Station.

EFFECT OF THE TESTING METHOD ON THE DETERMINATION OF CORROSION RESISTANCE. By H. S. Rawdon and E. C. Groesbeck. 38 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 367 of the Bureau of Standards.

AN INVESTIGATION OF WEB STRESSES IN REINFORCED CONCRETE BEAMS. PART II—RESTRAINED BEAMS. By Frank E. Richart and Louis J. Larson. 76 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 175 of the Engineering Experiment Station. Price 45 cents.

CAMS—LAY-OUT AND DRAFTING. By Louis Rouillion. 38 pages, 5 1/4 by 7 1/4 inches. Published by the Norman W. Henley Publishing Co., 2 W. Forty-fifth St., New York City. Price, 75 cents.

This is a new revised and enlarged edition of a work on various forms of cams and their design. It contains suggestions for laying out cams and drawing typical forms.

WHERE INDUSTRY CLASPS HANDS WITH EDUCATION AND BOTH GAIN. By Arthur Williams. 16 pages, 6 by 9 1/4 inches. Distributed by the New York Edison Co., Irving Place and 15th St., New York City.

This little pamphlet describes the educational activities of the New York Edison Co. and the courses offered to employees of that company.

JOINT WIPING AND LEAD WORK. By William Hutton. 82 pages, 5 by 7 1/2 inches. Published by the Scientific Book Corporation, 15 E. Twenty-sixth St., New York City. Price, \$1.

This is a revised and enlarged edition of a little treatise on the preparation of lead pipe and connection and the wiping of joints in various positions. The book gives practical information

on the actual work, together with a large number of illustrations showing the best methods to follow under varying conditions.

EVERYBODY'S AVIATION GUIDE. By Victor W. Page. 247 pages, 5 by 7 1/2 inches. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price, \$2.

This book has been prepared to meet the demand for a simplified book on aviation that would be suitable for young people, beginners, and all other persons who wish to acquire general information without having to go through a mass of technical detail. The material is presented in the form of a series of lessons or instructions, starting at the beginning of the subject and outlining the elementary aerodynamical rules for the various forms of flying machines. Typical forms of airplanes and dirigible balloons are described, as well as their control systems, and the functions of the different parts, and the various types of airplane power plants in both air- and water-cooled forms are covered briefly. The book is illustrated with numerous specially prepared explanatory diagrams, as well as photographic reproductions of the latest type of airplanes.

NEW CATALOGUES AND CIRCULARS

HACKSAW BLADES. Diamond Saw & Stamping Works, Buffalo, N. Y. Price list of "Sterling" high-speed steel hacksaw blades for power machines.

ELECTRIC FITTINGS. Crouse-Hinds Co., Syracuse, N. Y. Bulletin 2112, containing data on conduits for railway mail car lighting and fan installations.

STRAIGHTENING ROLLS. Kane & Roach, Syracuse, N. Y. Bulletin 51, containing data on Kane & Roach standard straightening rolls, sizes Nos. 1 to 5.

FORGING MACHINES. National Machinery Co., Tiffin, Ohio. National Forging Machine Talk No. 66, discussing forging machine die design for deep piercing.

COMPRESSORS AND VACUUM PUMPS. Ingersoll-Rand Co., 11 Broadway, New York City. Bulletin 3150, on class ER and FR compressors and vacuum pumps.

ELECTRIC MOTORS. Reliance Electric & Engineering Co., 1053 Ivanhoe Road, Cleveland, Ohio. Bulletin 1087, illustrating various designs of Reliance alternating- and direct-current motors.

TOOLS AND DIES. Standard Die & Tool Co., Inc., Berkeley, Cal. Monthly publication called "The Toolmaker," containing information relating to tools, dies, and other equipment for toolmakers.

STEEL STRINGERS. Midwest Steel & Supply Co., Inc., Bradford, Pa. Bulletin SC-2 illustrating and describing the application of steel stringers for supporting overhead equipment in industrial plants.

FUSES. Trico Fuse Mfg. Co., Milwaukee, Wis. Bulletin 206-B, describing "Trico" powder packed renewable fuses. The bulletin contains engineering data and the results of tests on overload time lag and watt loss saving.

WIRE-WORKING MACHINERY. Baird Machine Co., Bridgeport, Conn. Circular illustrating and describing Baird wire-working machines, automatic power presses, horizontal chucking machines, tumbling barrels, etc.

CRANES AND FOUNDRY EQUIPMENT. Whiting Corporation, Harvey, Ill. Bulletin 184, descriptive of the Whiting new model B cupola. Bulletin 185, illustrating and describing a hand power crane equipped with roller bearings.

NICKEL CAST IRON. International Nickel Co., Inc., 67 Wall St., New York City. Bulletin 206 in a series on data and applications of nickel cast iron. This bulletin gives data on the wear and machineability of cast iron.

TURRET LATHES. Jones & Lamson Machine Co., Springfield, Vt. Circular illustrating

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Wetmore Cylinder Reamer reaming cylinder of a Continental Motor in Detroit plant.

CONTINENTAL Motors don't guess about Cylinder Reamers. The great reputation of the famous Continental Red Seal Motor is too important. They search until they find the reamers they can depend on, and then they stick to them. It is significant that for years, Continental Motors have used Wetmore Adjustable Cylinder Reamers in both their Detroit and Muskegon plants.

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a job, consisting of the machining of bar work on the Jones & Lamson flat turret lathe. The successive steps and the time required are given.

POWER TRANSMISSION MACHINERY. Winfield H. Smith, Inc., Springfield, N. Y. Booklet No. 8, completely describing this company's line of speed reducers, hangers, pillow blocks, and other light power transmission machinery.

INDUSTRIAL BRUSHES. Hanson - Van Winkle-Munning Co., Matawan, N. J. Bulletin 10, illustrating and describing this company's complete line of industrial brushes for the cleaning and finishing of metal, glass, rubber, and other surfaces.

AIR CONDITIONING EQUIPMENT. Carrier Engineering Corporation, Newark, N. J. Bulletin descriptive of the Carrier unit air conditioner for automatically controlling conditions of temperature and humidity to suit the manufacturing process.

SAWS AND CUTTING-OFF EQUIPMENT. E. C. Atkins & Co., 402 S. Illinois St., Indianapolis, Ind. Spring number of "The Saw Kerf," a quarterly publication containing interesting and valuable information on the subject of saws for all purposes.

GEAR-HOBBERS AND THREAD MILLERS. Adams Co., 1905 Market St., Dubuque, Iowa. Circular illustrating the Adams gear-hobber and thread miller, and describing its use in the production of Barnes all-gear drills and honing machines.

FILING SYSTEMS. Globe-Wernicke Co., Cincinnati, Ohio. Booklet on a system for the filing and indexing of drawings, plans, maps, and similar large sheets. A number of installations and various types of filing units are shown in the booklet.

SHEET-METAL WORKING MACHINES. Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. Booklet containing data on Niagara bar folders, combination bench machines, crimpers and bead-ers, groovers, formers, mandrels, shears, etc.

COUNTING DEVICES. Bristol Co., Waterbury, Conn. Bulletin 365, containing information on Bristol barrel-type counters for automatically counting revolutions or strokes on automatic machines of all kinds, where mechanical operations are to be counted.

INDICATING AND RECORDING INSTRUMENTS. Brown Instrument Co., 4451 Wayne Ave., Philadelphia, Pa. Bulletin entitled "Paid for Themselves in a Week," illustrating the use of Brown recording thermometers and pressure gages in a wide variety of industries.

CASEHARDENING COMPOUNDS. Case-hardening Service Co., 2281 Scranton Road, Cleveland, Ohio. Circular containing information on "Service" pressed-steel pots for cyanide, salt, and lead hardening. Circular giving data on "Drawite" salts for drawing and tempering steel.

ELECTRIC CONTROL EQUIPMENT. Monitor Controller Co., Gay, Lombard and Frederick Sts., Baltimore, Md. Bulletin 110, entitled "Speeding up Production with Automatic Control," illustrating applications of Monitor electric controllers on various types of machine tools.

FLEXIBLE SHAFTS AND EQUIPMENTS. N. A. Strand & Co., 5001-5009 N. Lincoln St., Chicago, Ill. Catalogue 24, covering the Strand line of flexible shaft equipments for use in grinding, polishing, buffing, sanding, drilling, reaming, nut-setting, screwdriving, and many other operations.

ELECTRIC EQUIPMENT. Monitor Controller Co., Gay, Lombard and Frederick Sts., Baltimore, Md. Bulletin 112, containing data on "Thermaload" starters, including ratings, dimensions and weights of the various types, as well as price lists and instructions for installation and care.

HONING MACHINES. Barnes Drill Co., 814 Chestnut St., Rockford, Ill. Bulletin 100, entitled "Honing vs. Internal Grinding," outlining the advantages of the honing process and illustrating the various sizes of honing machines made by this concern, which take cylinders from 1 up to 50 inches in diameter by 7 feet long.

CHAIN DRIVES. Boston Gear Works Sales Co., Norfolk Downs, (Quincy), Mass. Catalogue of Renold-Boston chain drives, containing selection charts and data on single-roller, duplex-roller and silent-chain drives, as well as compound reduction drives. Instructions are also given on the care and lubrication of chain drives.

HEAT-TREATING EQUIPMENT. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Circular No. 9 in a heat-treating series, discussing the subject of tempering. The circular illustrates the Homo electric tempering furnace and describes the Homo method of tempering work, which utilizes air as a heating medium.

INTERCHANGEABLE COUNTERBORES. Eclipse Interchangeable Counterbore Co., Detroit, Mich. Catalogue 28, describing the Eclipse line of interchangeable counterbores, countersinks, spot-facers, hogging cutters, multi-diameter cutters, core drills, high-speed steel centers, and special tools. The catalogue is provided with a thumb-index for ready reference.

GRINDING MACHINES. Blanchard Machine Co., 64 State St., Cambridge, Mass. Catalogue 16, containing detailed description and illustrations of the Blanchard No. 16 high-power vertical surface grinder. The catalogue also contains a large number of illustrations showing typical work for which the machine is adapted, together with production data.

SAWS. E. C. Atkins & Co., Inc., 402 S. Illinois St., Indianapolis, Ind. General catalogue 20, containing data on the complete line of saws and knives made by this company, including circular saws, inserted-tooth saws, cross-cut saws, saw swages, saw guide and setting

machines, saw mandrels, machine knives, metal-cutting machines, hacksaw blades, grinding wheels, "Cantol" belt wax, files of all kinds, etc.

SMALL TOOLS. Scully-Jones & Co., 1913 S. Rockwell St., Chicago, Ill. Small tool catalogue No. 36, superseding all previous issues. The catalogue illustrates the complete line of Scully-Jones production tools, including tools for drilling, tapping, milling, reaming, counterboring, and spot-facing operations. Detailed specifications are given, and the commercial standards adopted by tap and die manufacturers are included.

ELECTRICAL EQUIPMENT. General Electric Co., Schenectady, N. Y. Circulars GE-A-233-B, 308-A, 752, 835-A, 894, 934, 948, and 950, illustrating and describing, respectively, electrically driven centrifugal single-stage air compressors, arc suppressor plates for drum controllers, direct-current motors, magnetic controllers, adjustable-speed direct-current motors, automatic throw-over panels, and starting rheostats.

HERRINGBONE GEARS. Palmer-Bee Co., Detroit, Mich. Catalogue treating of the P.B. Sykes continuous-tooth herringbone gears. The book also describes this company's line of herringbone and improved mill type spur gear speed reducers. It contains tables of horsepower ratings and dimensions of standard size units, a list of the advantages as compared with open drives, instructions regarding lubrication, installation, etc.

PULLEYS. Reeves Pulley Co., Columbus, Ind. Catalogue 88, descriptive of the new design Reeves variable-speed transmission. The book is arranged in six parts, under the following headings: Construction and operating principle; composite designs, remote controls, and accessory parts; automatic control; adoption of the Reeves variable-speed transmission as standard equipment; industries now using Reeves transmission; engineering information, covering all sizes and types of Reeves variable-speed transmissions, including blueprints giving complete dimensions of all sizes and designs. Pamphlet 88-A, containing list prices for Reeves variable-speed transmission and replacement parts.

GRINDERS, HEAVY MACHINE TOOLS. SPECIAL PRODUCTION MACHINERY CRANES, ETC. Shaw Crane-Putnam Machine Co., Inc., Pershing Square Building, 100 E. Forty-second St., New York City. Bulletin entitled "To Help you See Us as We See Ourselves," in celebration of the ninety-second anniversary of the company, showing illustrations of the various departments in the plant, as well as examples of the different lines of machines built, including planers, horizontal boring, milling and drilling machines, special heavy-duty machine tools for industrial and railroad service, heavy lathes, resquaring shears, rotary slitters, billet peelers, planer-type grinders, valve facing machinery, and cranes.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST, 24, 1912

of MACHINERY, published monthly at New York, N. Y., for April 1, 1928.

State of New York } ss.
County of New York }

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of the Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, and Robert B. Luchars, Vice-president, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Robert B. Luchars; Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars;

Nellie I. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 20th day of March, 1928.

CHARLES P. ABEL,

Notary Public, Kings County No. 231

Kings Register No. 9050

(SEAL) New York County No. 77, New York Register No. 9089
(My commission expires March 30, 1929.)